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COMPUTER DIRECTED TRAINING:  
SYSTEM 473L QUERY LANGUAGE

J. D. Schiff  
M. L. Chenevert  
W. F. Bennett

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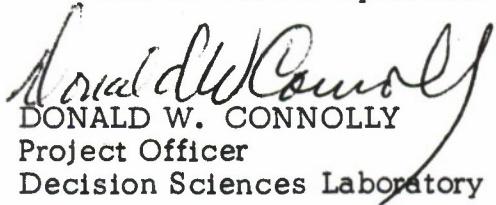
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## FOREWORD

One of the research goals of the Decision Sciences Laboratory, Electronic Systems Division, is the development of design principles for automated training subsystems which could be built into future Information Systems. Task 768204, Automated Training for Information Systems, under Project 7682, Man-Computer Information Processing, was established to develop a technology for these training subsystems. This report is one in a series supporting Project 7682, Task 768204. The study was undertaken by the Decision Sciences Laboratory in support of the 473L System Program Office. Dr. Sylvia R. Mayer of the Decision Sciences Laboratory, served as Air Force Task Scientist and Contract Monitor. Dr. William Bennett was principal investigator on contract no. AF 19(628)-5541 with International Business Machines.

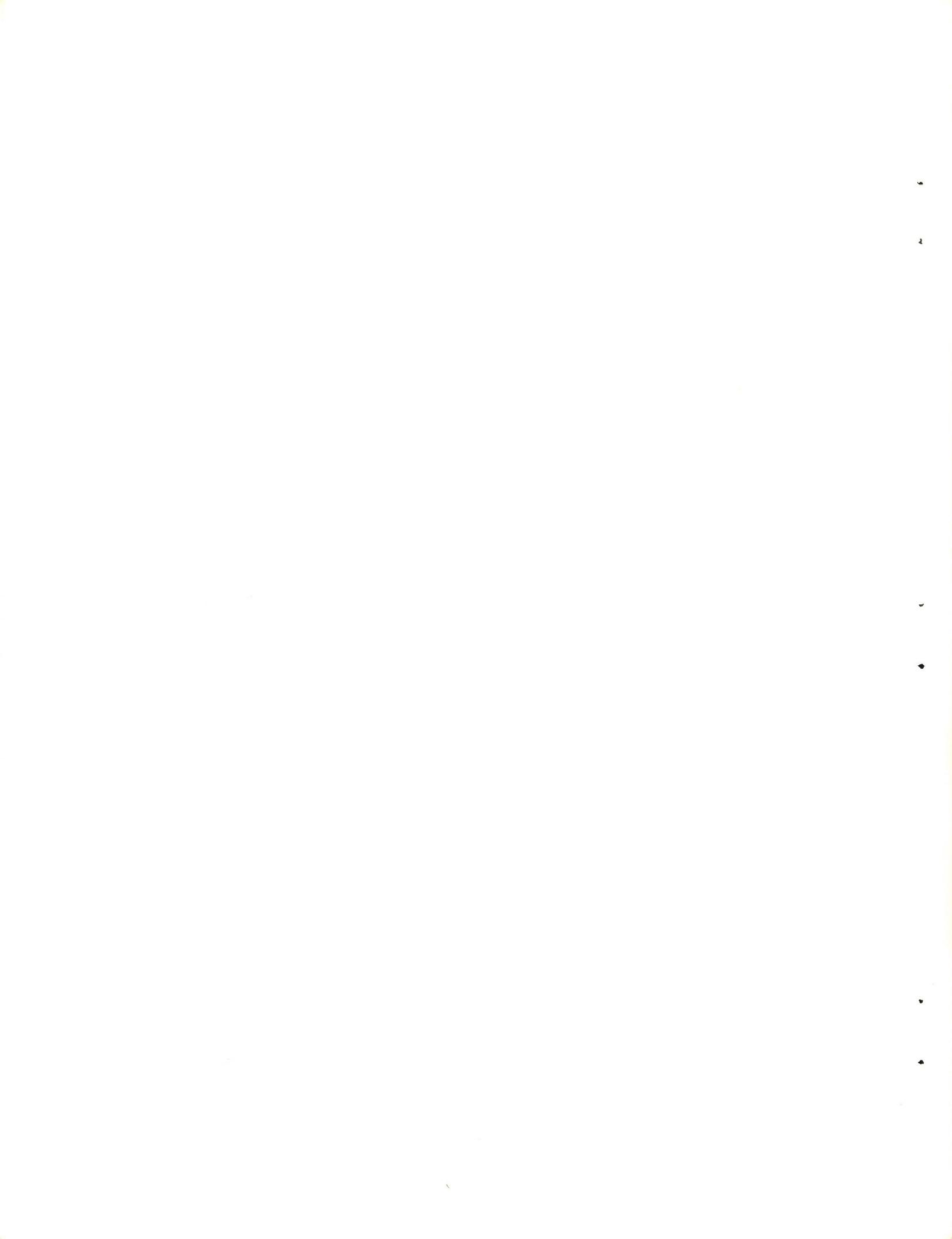
This technical report has been reviewed and is approved.

  
DONALD W. CONNOLLY  
Project Officer  
Decision Sciences Laboratory

  
ROY MORGAN  
Colonel, USAF  
Director, Decision Sciences  
Laboratory

## ABSTRACT

This document describes the results of a programming analysis of a Computer Directed Training (CDT) capability as specified in a preliminary document developed by the American Institutes for Research entitled "Operational Specification for Computer Directed Training in Intermediate Query Language, Model II, for System 473L, U. S. Air Force Headquarters", February, 1966. The programming analysis report describes a method for implementing the CDT capability and discusses the impact on System 473L operational utilization. Conclusions regarding the implementation of the CDT capability are supported by a discussion of data storage, handling, and maintenance procedures; descriptions of data areas and subprograms; and a program flow chart with a listing of program logic steps.



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## Section 1

### INTRODUCTION

#### 1.1 BACKGROUND

One of the problems most critical to the effectiveness of semi-automated command and control or resource management systems is communication between system operators and automatic data processing elements of the system. Computer languages used in automatic data processing tend toward rigidity and frequently are specific to particular equipment; hence, they are not suitable for communication between a commander or his staff and the computer. Conversely, the English language as it is typically written or spoken in a command environment tends to be too imprecise and ambiguous for equipment interpretation. Solutions to this problem generally have involved the utilization of mechanical aids such as logic pushbuttons and light pencils or constrained versions of the English language which can be interpreted by a computer program.

The development of such a constrained English language has been one of the approaches taken for man-machine communication in System 473L. (See Appendix A for a brief description of System 473L.) This language, called Query Language, is composed of a precisely defined vocabulary, grammar, syntax, and punctuation set. The system operator, using the Electronic Typewriter element of the Integrated Console, constructs a Query Language statement which is similar in structure and logic to an English language statement. This statement directs the computer program to retrieve data from any file in the system or to perform certain other functions. The format and punctuation of the statement indicate the necessary processing; the language describes the desired data, its format, and the output device to be used.

Although operator recall of the language and its rules is facilitated by the design of the Query Language, training requirements are not eliminated. The effective use of the Query Language requires the system operator to be knowledgeable about the structure of the system data base and about restrictions on the language regarding vocabulary, syntax, grammar, and punctuation.

The military command environment contains many elements which influence the way in which training can be provided. In a command and control system, it is highly desirable that personnel of the commander's staff be the system operators or the users of the system. They are charged with the responsibility for carrying out predefined missions in the name of the commander, and are so selected because

of the military judgment and professional experience which they can apply to impending or existing operational situations. The large number of staff personnel at a major headquarters level can pose a significant training problem: difficulties are encountered in matching training schedules with normal duty requirements of personnel; accelerated operational conditions may disrupt training schedules; and transfers in and out add to the problem of maintaining efficient training courses. Thus, the need for an on-the-job training capability becomes apparent.

Computer directed training can be effectively applied in such a situation. This technique has many advantages. For example, the sequence of instructional material is of a highly individual and personalized nature. The training situation takes advantage of the high, self-motivating power of game-like situations. The trainee obtains immediate knowledge of results (a highly significant factor in teaching a correct response pattern), while at the same time he may receive, for a command and control system, actual performance training. In addition, this technique allows a high degree of accuracy in measuring operator proficiency. Finally, a computer directed training technique permits more flexible training schedules and maximizes the training output from a given investment of operator and computer time.

## 1.2 SUMMARY

Under contract to the Electronic Systems Division, IBM has provided consultant services to the American Institutes for Research in the development of an "Operational Specification for Computer Directed Training in Intermediate Query Language, Model II, for System 473L, U. S. Air Force Headquarters." This document specifies a Computer Directed Training (CDT) capability for training of personnel, using a teach-test-review sequence, in the composition and functions of Query Language statements. In addition to providing consultant services, IBM was responsible for determining the feasibility and techniques of implementing the Computer Directed Training capability according to the 473L standards. More specifically, IBM was responsible for (1) ensuring compatibility of the training logic flow with 473L system characteristics; (2) determining whether the CDT capability can be integrated into the 473L system and utilized in much the same manner as the System 473L operational capabilities; and (3) identifying the impact of the CDT capability on system operational response, data storage, and capability maintenance requirements.

The Computer Directed Training capability specified for System 473L provides trainees with a basic introduction to the system prior to detailed training in Query Language. Instruction is presented in small incremental steps, requiring frequent response by the trainee and allowing him to progress at his own rate.

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\* "Operational Specification for Computer Directed Training in Intermediate Query Language, Model II, for System 473L, U. S. Air Force Headquarters." Clapp, Doris; Shettel, Harris and Mayer, Sylvia. ESD-TR-66-252, Decision Sciences Laboratory, Electronic Systems Division, Bedford, Massachusetts.

The design of the capability provides for an automatic analysis of the trainee's responses and, relative to predetermined criteria of performance, directs the trainee to appropriate remedial training. The capability is also designed for research: two groups can be identified and receive different types of training for purposes of comparative evaluation.

As a result of a programming analysis, it has been determined that:

- The CDT capability can be designed so as to be compatible with System 473L equipment and programming subsystems. Approximately three instructions will have to be added to the Monitor Program to ensure proper terminating procedures subsequent to a training session. These additional instructions would be issued only twice during the operation of each capability overlay (initiation and termination) and would require a total of 60 microseconds for each overlay utilized.
- The CDT capability can be integrated into the system and utilized in much the same manner as existing operational capabilities using a CDT overlay.
- The CDT capability will have little impact on requirements for storage of System 473L operational data and operational capability programs. The CDT capability program and certain data (e.g., Student History Matrix, Error Matrix) will reside permanently on disk. The bulk of the data (Cue File Matrix) will reside on tape and will be called into temporary storage only when the CDT capability is being used. CDT will require only 3.9 percent of the unallocated permanent storage of the completed operation system and 15.1 percent of the remaining unallocated temporary storage, assuming allocation of permanent storage for CDT. An additional 2.6 percent will be required for each additional trainee. It is recognized that even more of the CDT capability could reside on tape, but it is felt that this would result in design inefficiencies and greater restrictions on simultaneous operations.
- The CDT capability will have no impact on the simultaneous utilization of System 473L operational capabilities. It is estimated that CDT can be operated (by three trainees concurrently) simultaneously with all other capabilities, excluding two of the following: Materiel Plan Modification/Evaluation, Forces Plan Modification/Evaluation, ACE Transport. This restriction, however, does not detract from system effectiveness since current estimates indicate that any two of these capabilities could not be operated simultaneously in the system even without the CDT capability. Use of the CDT capability will impact System response times in a manner similar to any other operational capability.

Cards will be used for maintenance and updating of the CDT capability controlled by the CDT overlay. Existing 473L file maintenance programs are not utilized and no unique requirements are imposed.



## Section 2

### CDT CAPABILITY SUMMARY

The Computer Directed Training capability is composed of two major elements: pretraining and training. The pretraining element, which provides a basic foundation for the course, presents material relating to the use of the data base and to overlay, console, and computer operation. The training element provides training in the structure and content of the Query Language.

The pretraining element consists of five sets (called pretest sets), each of which contains a teach section and a test section. The teach section consists of a series of cues\* (Q9's). The first cues in this section are used to present basic training material; the final cues are used to review this basic material. The teach section is followed by a test section consisting of cues (Q8's) used to determine the trainee's proficiency in the material just presented. A record of each trainee's incorrect responses is maintained in storage. Upon completion of the test section, the trainee is directed to appropriate remedial training within the teach section. Upon satisfactory completion of all pretraining sets, the trainee proceeds to the training element.

The training element consists of 20 sets: 13 independent sets, 6 cumulative sets, and one post-test set. Each independent set teaches a new segment of the Query Language material. A cumulative set, presented after a group of independent sets have been completed, provides review of all material presented since the last cumulative set. The procedure used in a cumulative set is the same as that used in an independent set. The post-test set is presented after all sets in the training element have been completed and provides for a review of all Query Language material.

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\* Two types of cues are used by this capability:

1. Instructional Cues—used primarily to instruct the trainee in the proper procedure for making a transition from one point in the training sequence to another. These cues usually indicate the available options for continuing, and in some cases provide feedback to the trainee regarding his performance on the last cue or series of cues.
2. Learning Cues—contain the test and test portions of the course material. These cues are sequenced so that the trainee will learn the desired material in a systematic manner.

Each training set consists of a teach section, a test section, and a free-form section. The teach section consists of cues (Q9's) which present the basic training material, provide for the review of that material, and then present a series of practice problems in using the Query Language elements taught in the preceding cues. This is followed by a test section consisting of problem cues (Q11's) used to evaluate the trainee's proficiency. The trainee's response to each test problem is checked for correctness and the result retained in storage.

To minimize complexity of computer error analysis while determining areas of weakness or strength, the course material is separated into major topics of instruction called "general categories." These general categories are further divided into specific elements of the text called "subcategories" ("subcats"). Examples of general categories in Query Language are Program Indicator, File Indicator, and Qualifier. Examples of subcategories in Query Language are the terms Retrieve, File Indicator used with GCD, and Format of Compound Qualifier. All problems are evaluated with respect to the general or subcategories. This evaluation is the basis for directing the trainee to appropriate remedial training as necessary.

Upon completion of the test section, the trainee's responses are compared, on a category basis, to predetermined criteria and classified as excellent, good, average, or poor. If the trainee is evaluated as excellent, he receives no remedial training; remedial training for an evaluation of good is excerpted from the practice problem cues; remedial training for an evaluation of average is excerpted from the review cues; and remedial training for an evaluation of poor is excerpted from the basic training material. After completing this directed remedial work, the trainee is directed to a free-form section.

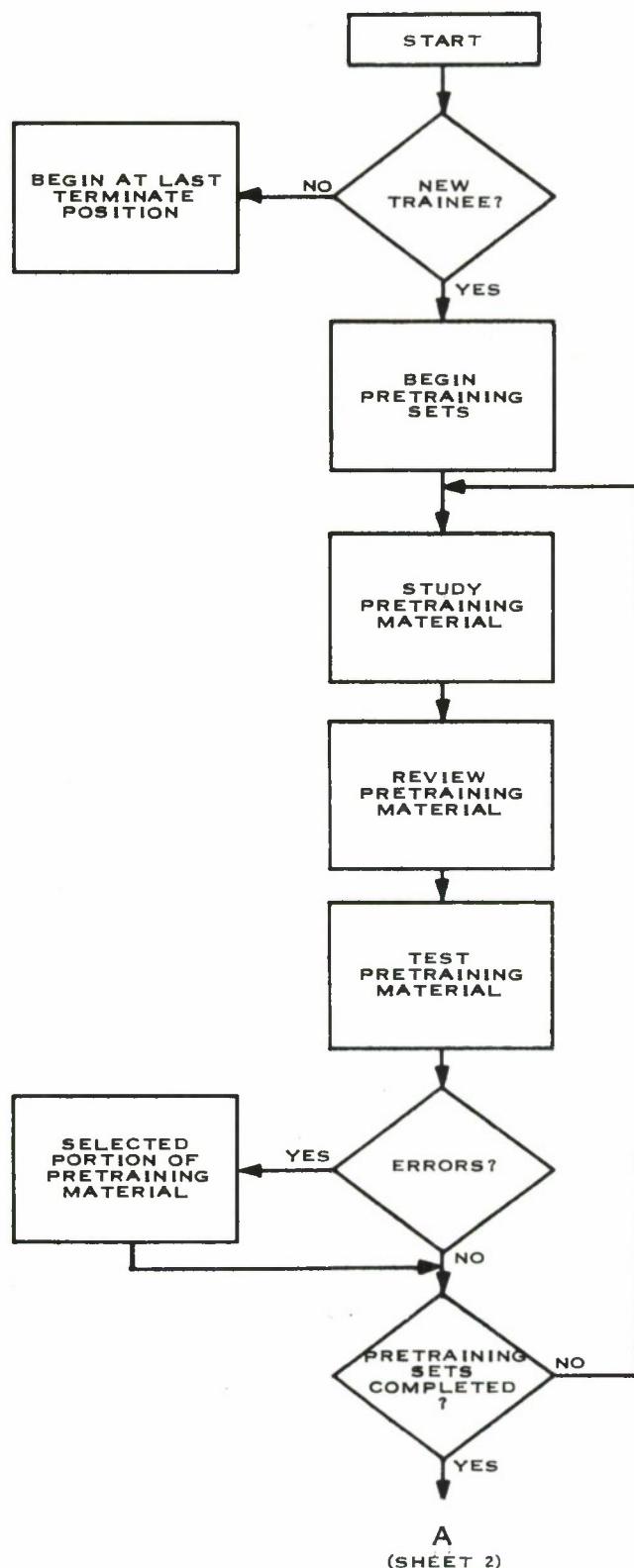
The free-form section consists of cues (Q19's and Q19A's) which give the trainee practice in developing complete QL statements as answers to specified problems. Because answer formats are not artificially segmented, as they are in the test section, these cues are called free-form practice exercises. The trainee types the entire QL statement as his answer. He is then shown the correct QL statement for each problem presented, and he compares his response to the correct response for purposes of self-evaluation. Since the trainee's answers in this section are not evaluated by the computer, the answer format used by the trainee does not constitute a problem for error analysis.

After the three sections of each training set are completed, the trainee is given the option of taking remedial work in one or more areas for which his responses in the last test section were evaluated. Since remedial work at this point is taken only by free choice and consists of review material from one of the last teach section, the remedial sequence that the trainee chooses to take at this point is called free choice review. After exercising his option regarding free choice review, the trainee is directed to the next set and proceeds in the manner indicated above.

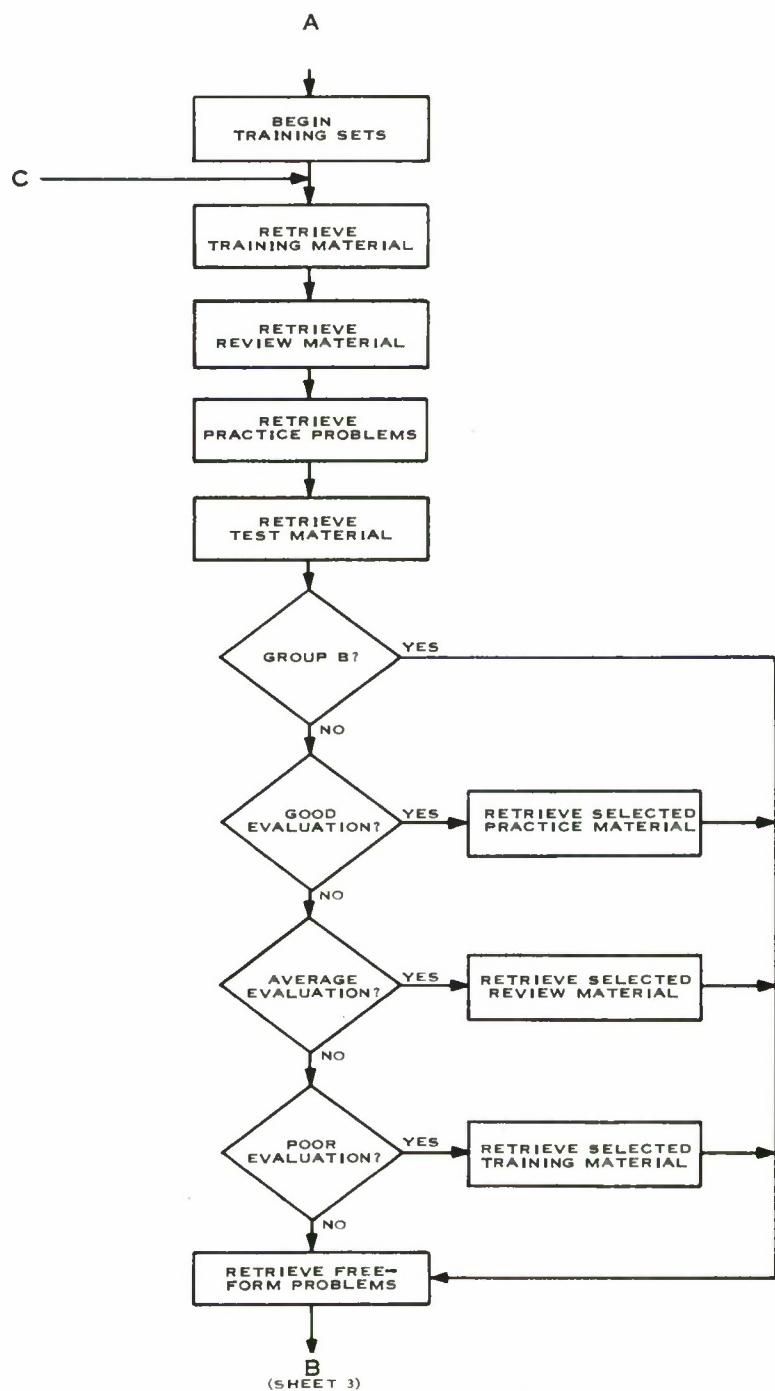
When all sets in the training element have been completed, a post-test set is presented. This set reviews the total content of the course by presenting comprehensive problems on all the training received. Based on an analysis of errors as described earlier, the trainee is then redirected to appropriate remedial training. Subsequently, he is retested on only those portions of the preceding test section on which he made errors, and total errors are tabulated. The student then is given the option of additional free choice review. After exercising this option, the student has completed Query Language training, and his performance is appraised by the instructor.

The training sequence described above is the most comprehensive afforded a Query Language trainee. The CDT capability, however, has an additional sophistication in that it is designed to collect comparative statistics for research purposes. Trainees are alternately assigned to one of two groups, Group A and Group B. The essential difference between the two groups is that Group A will be trained as described above, while Group B will receive no directed remedial training. Group B, however, will be given the option of free choice review. Both groups will be treated alike during the post-test set.

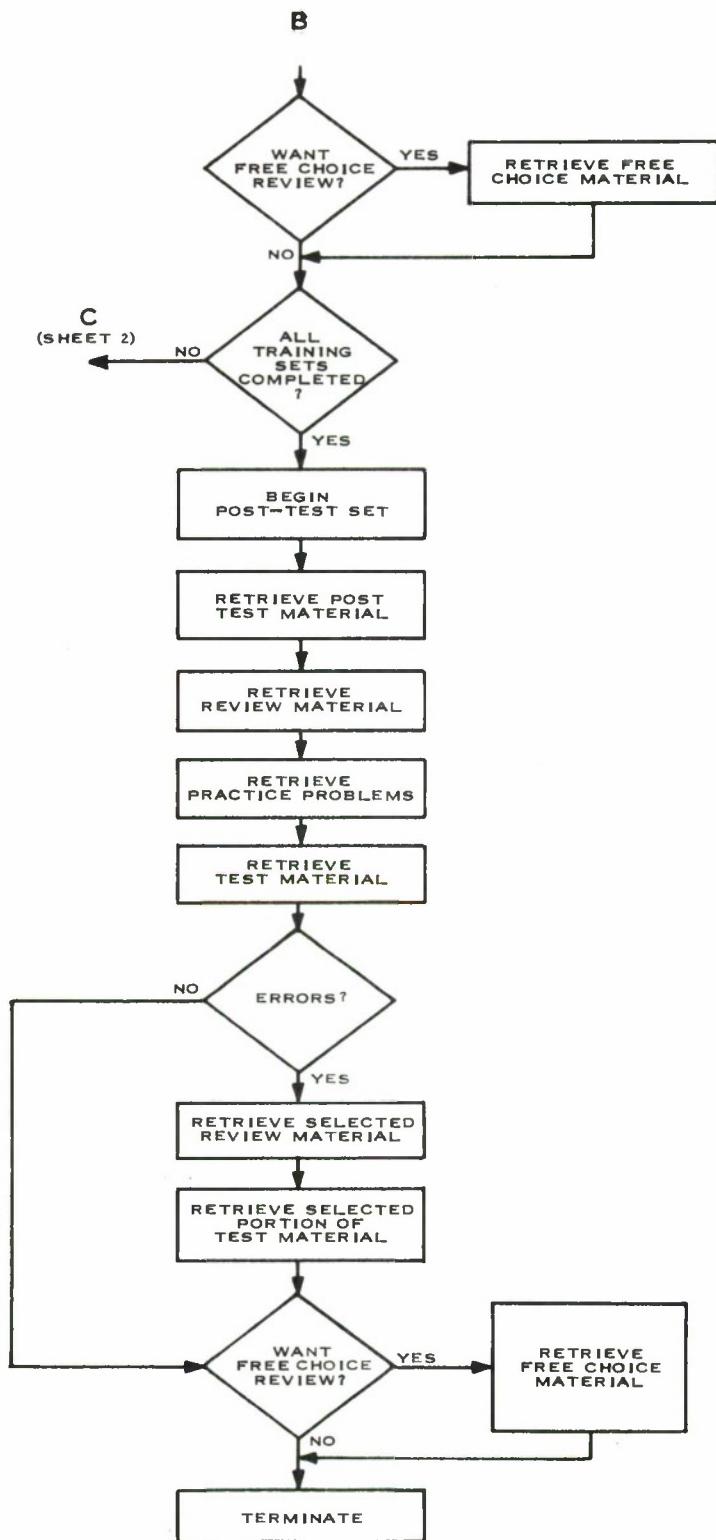
A simplified logic flow is shown in Figure 1.



*Figure 1*  
*Simplified Logic Flow (Sheet 1 of 3)*



*Figure 1*  
*Simplified Logic Flow (Sheet 2 of 3)*



*Figure 1*  
*Simplified Logic Flow (Sheet 3 of 3)*

## Section 3

### PROGRAMMING ANALYSIS

Analysis of the CDT capability for purposes of implementation emphasized three major areas: data storage, data handling, and data maintenance.

#### 3.1 DATA STORAGE

The three most popular storage devices are tape, cards, and disk, depending upon type of computer environment. Since System 473L is disk oriented, it would appear that the elements comprising the CDT capability should be stored on disk for most efficient input and output of information. However, available disk space is limited, and placing all of CDT on disk would significantly impact system utilization. On the other hand, if tapes or cards were used predominantly, system responsiveness and reliability would be affected. To achieve a storage equilibrium which did not seriously impact the system, the program and certain data areas (such as Flex Course Matrix Criteria Matrix) were placed on disk, and the Cue File Matrix (largest of all areas) was placed on tape.

Storage estimates for the CDT capability are shown in Table 1. The CDT capability requires 3.9 percent of the total remaining disk (176,000 blocks) for permanent storage. The total remaining disk available for temporary storage is reduced to 169,042 blocks. To operate, the CDT capability requires 15.1 percent of these remaining blocks for temporary storage and, for each additional student trained concurrently, an additional 2.6 percent is required.

The CDT capability (used by three trainees concurrently) and all 473L operational capabilities, excluding any two of the following, can be operated simultaneously: Materiel Plan Modification/Evaluation, Forces Plan Modification/Evaluation, and ACE Transport (assuming maximum conditions for the operational capabilities). This restriction, however, does not detract from system utilization since, even without the CDT capability, the same condition applies.

Table 1

## Estimated Storage Requirements (Blocks)

REQUIREMENTS FOR PERMANENT STORAGE		REQUIREMENTS FOR TEMPORARY STORAGE	
CDT	(COC Configuration)	472,000 <sup>1</sup>	Total
Student History Matrix <sup>2</sup>	1140	Cue Director Matrix	235
Error Matrix	133	Cue File Matrix	20932
Evaluation Matrix	1370	Program Tables	4500
Summary History Matrix	10		
Criteria Matrix	1		
Flex Course Matrix	1		
Program Area <sup>3</sup>	4303		
		6,958	Total
			25,667 <sup>4</sup>

1. Total disk contains 648,000 blocks; therefore 176,000 blocks are still available. See Appendix B for a listing of all capabilities included in the estimate.
2. This figure is based on 20 students. This matrix requires 57 blocks per student; the Operational Specification defines a minimum of 20 students for a trial basis.
3. Includes instructions, constants, and necessary tables.
4. This reflects the requirements for one trainee; each additional trainee operating concurrently would require an additional 4500 blocks.

### 3.2 DATA HANDLING

After determining storage residence, the method of calling in data stored on tape was selected from the following two alternatives:

1. Read the tape in segments, thereby utilizing a minimum amount of temporary disk at any given instant, or
2. Read the complete tape at once, and work from this temporary area.

The method described in Alternative 1 is inefficient (involves various bookkeeping routines, etc.), time consuming, and results in decreased reliability. Therefore, Alternative 2 was selected as the best method.

Even with one complete tape read, the time required for tape operation is long and tedious. As a result, the program is designed to issue one tape call for all consoles using the CDT overlay concurrently. To accomplish this, it is necessary to assign a temporary "permanent" disk symbol (containing the cues) for the life (during any given period) of all consoles\*. The symbol is assigned by the first console operated as the cues are read in from tape to disk and becomes accessible to any subsequently operated console. When the last of the CDT consoles is to be deactivated, the student is required to follow specific terminating procedures. These, in turn, direct a subroutine to deallocate the disk symbol.

A problem could arise if a study should terminate incorrectly and, by so doing, leave the symbol occupying what would otherwise be available disk space. To eliminate this problem and double check each student, the monitor subprogram (BF05) handling housekeeping chores will be revised so that every time it receives control via depression of the COMPL OPER button (or START button if COMPL OPER had not been pressed), a decision box will determine whether the console had been operated by a CDT overlay. If so, the subprogram branches to a CDT routine which executes the proper terminating instructions and deallocates the cue symbol if no other CDT consoles are currently in operation. Upon completion of this chore, control will be returned to the subprogram.

Since the number of cues (estimated at 2500) is considerable, it would be a waste of execution time and storage space to carry blank lines with each cue and continually include information common to more than one of them. This has been eliminated by (1) building the cues on a line by line basis, thereby retraining them in a compressed pattern, and (2) creating special cues to contain repetitive groups

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\*During CDT program operation, all permanently allocated symbols and dynamically updated data portions (such as the contents of the Student History Matrix) will be handled in the update mode to allow automatic (monitor controlled) transmission to the other computer's disk. Refer to System 473L Technical Memorandum 282 for a description of this concept and generally of the COC design phase. In the event that this feature is not incorporated, the CDT capability will be handled in the same manner as the 473L operational capabilities.

of information. Just prior to display, each cue is expanded to correct display format and has placed in it the proper information from the appropriate special cue. For example, there are 1990 Q9's which in display format contain 33 lines. On tape only eight lines are reserved for each Q9. One "special" Q9, containing the remaining 23 lines, is added to each Q9 before display.

### 3.3 DATA MAINTENANCE

For any computer effort, program design must allow for addition to and deletion from the data base. The CDT base includes five data areas: Cue File Matrix (CFM), Evaluation Continuation Matrix (ECM), Error Matrix, Flex Course Matrix, and Criteria Matrix.

#### 3.3.1 Update Procedures

Information for tape and disk update is transmitted to the system via cards. The composition and function of these cards are described below:

Header Card—indicates that a data base matrix is to be updated. If an individual wishes to update more than one matrix (or cue) at any given time, he will have an equivalent number of header cards in the card deck. A header card contains the following information:

1. Type of card
2. Identification: For Cue File Matrix, a cue ID; for other four areas, symbolic disk addresses.
3. Option: Used only with the CFM and then only if the number of cues in the training sequence logic is to be increased or decreased.

Support Card—contains the new material for a matrix. One or more associated with each header card. A support card contains the following information:

1. Type of card
2. Line Number: For Flex Course Matrix, the number of the item to be changed; for CFM, the line number corresponding to the display area; for Evaluation Continuation Matrix, a combination of characters representing set, subcat number, student work classification; for Error Matrix, set number, subcat number; for Criteria Matrix, set type, error standard.
3. Information: For Flex Course Matrix, the value of the updated item; for all other data areas, the content per line not appearing in line number (refer to table format of each matrix, Section 4).

Before initiating an update, the instructor calls the computer operator to inform him that he is ready to update and to ensure that the cards are set and tapes are available (if required). He then positions his overlay and depresses the update key, which in turn calls in the working program to perform the update. When the Cue File Matrix is changed, two tapes are utilized: a scratch tape which receives the new output, and the Cue File Tape (which becomes a scratch tape after completion). When the data on disk is to be changed, the program inserts the new input and reallocates the symbol if necessary.

The following example illustrates the use of header and support cards in updating the Cue File Matrix.

If a non-blank character is present in the Option Field, indicating deletion, no support cards are necessary. The cue is removed from the matrix and a new tape written. If the Option Field indicates addition, each support card will be added under the cue ID to form a new cue, which is then placed in the proper sequence of a set. As a result of either case, the program will adjust the frame numbers (in cue ID) of all cues in the same set. When the Option Field contains a blank, a tape search for the header card cue ID occurs. Once located, each line of the cue represented by a support card is updated with the corresponding information.

If the number of sequences for a certain set subcat number, and student work classification in the ECM is to be changed, the instructor must create the support cards to revise the actual sequences and number of sequences accordingly (refer to table format of the ECM). Modifying or updating the training material does not require that the instructor be a programmer; however, changes to the design of the computer program must be accomplished by an experienced programmer.

### 3.3.2 Restrictions

In updating the data base, the following restrictions must be noted:

1. A given run must not contain matrices from both tape and disk.
2. Training and maintenance periods are mutually exclusive events.
3. It is the responsibility of the instructor to order updated cues in a correct sequence (by set, type, and frame number). Failure to do so will result in an error message.
4. When the Cue File Matrix is to be updated, the instructor must request a tape load from the computer operator. Failure to do so will result in the generation of an error message.



## Section 4

### PROGRAM DESIGN APPROACH

This section describes the common data areas, programs, and other facets of the program design identified with the CDT capability and presents an overall picture of the basic computer logic configuration. It is important to note that this report is not a Program Design Concept and should not be considered as such. Descriptions are brief and generalized. The main intent has been to lay the groundwork for piecing together the methods and procedures necessary for detailed program design. Some familiarity with the contents of the CDT Operational Specification (Op Spec) is assumed and will be required to fully comprehend the terminology and structural logic.

Descriptions of the data areas include, for the most part:

- Title
- Function
- Item Definition
- Table Format
- Storage Estimates
  - Residence
  - Type
  - Size
- Basis of Computation

Each program is described in the following terms:

- Program ID
- Functional Design

The first two digits of the program ID determine the status assigned to the program; i.e., SP for service program, WP for working program. A discussion concerning the meaning of these terms can be found in Appendix B.

## 4.1 COMMON DATA AREAS

Described below are the eight common data areas unique to the CDT capability. Additional data areas, with negligible storage requirements, are also defined.

### 4.1.1 Student History Matrix (SHM)

#### Function

To record actions and progress of a student during the learning process.

#### Item Definition

		Characters per Item
A1*	Sequential Student Number—assigned to a student upon entering the course. Odd number implies Group A. Even number implies Group B.	(2)
A2	Trainee Name	(16)
A3	Trainee Serial Number	(10)
A4	Cumulative Training Time	(4)
A5 (I)	Percent Error on Pretest Sets—contains student's rating for each pretest set. Since there are five such sets, the I will differentiate one from another. Before a set is completed, these areas will contain the number of errors committed by a student.	(2)
A6	Begin Run Time—from initial cue for a given run.	(4)
A7	End Run Time—from last exhibited cue for a given run.	(4)
A8	Continuation Point—a trainee may terminate a session on almost any displayed cue. This item will restart him at his last breakoff point by branching to the proper program step.	(2)
A9	Cue ID of Previously Exhibited Learning Cue	(6)
A10	Cue ID of Next Learning Cue to be Displayed	(6)
A11	Current Subcat Number—during review contains each subcat under examination.	(3)

\*In further discussion, items within the Student History Matrix will be referenced by bracketed code number, e.g., [A21 (L)] for path site, [A2] for trainee name.

A12	Try--enables a trainee to retake a problem twice (maximum).	(1)
A13 (J)	Post-Test Problem Number--J designates each of the 15 post-test problems	(2)
A14 (J)	Number of Errors First Try--associated with [ A13(J) ].	(2)
A15 (J)	Number of Errors Second Try--associated with [ A13(J) ].	(2)
A16 (K)	Subcat Number--K ranges from 1 to 120; represents all subcats used for set evaluation.	(3)
A17 (K)	Cumulative Percent Error--cumulative program total (excluding post test); ratio between actual number of errors and possible number of errors	(2)
A18 (K)	Number of Errors in Current Set--totals by subcat the number of errors committed by a student for the current set. Will also contain "Cumulative Percent Error, Post-Test Set, First Try" upon completion of course material.	(2)
A19 (K)	Number of Errors in Problem--per subcat for the current problem.	(2)
A20 (K)	Free Choice--a count of the number of times each subcat was chosen for free choice review.	(2)
A21 (L)	Path--L ranges from 1 to 1080. Lists the type of remedial work assigned to a student. Composed of a five-character code containing set, subcat number, work classification.	(5)

#### Storage Estimates

Residence: Disk

Type: Permanent

Size: 57 blocks per student

#### 4.1.2 Error Matrix

##### Function

To evaluate the quality of work performed by a student.

##### Item Definition

B1 Number of Errors--represents the maximum number of possible errors for each set.

B2 Set Number—there are 25 regularly defined sets: 5 pretest, 13 independent, 6 cumulative, and 1 post test. Each problem of the post test will be considered as part of an additional "pseudo set," created for the purpose of retrieving number of errors per post-test problem.

B3 Subcat Number—for the pretest sets, has a fixed value of 0. For the independent, cumulative, and post-test sets, assumes a value from 1 to 120 (representing each of the designated subcat numbers). For the pseudo set, represents each post-test problem.

Table Format

# Errors	Set No.	Subcat No.
<u>XXX</u>		<u>Y ZZZ</u>

Storage Estimates

Residence: Disk

Type: Permanent

Size: 133 blocks

Basis of Computation:

(number of characters per line) (number of pretest sets) (subcat value)  
= number of characters

Pretest Sets: 7 (5) (1) = 35 characters

Cumulative, Independent, Post Test: 7 (20) (120) = 16,800

Pseudo Set: 7 (1) (15) = 105

4.1.3 Evaluation Continuation Matrix (ECM)

Function

To retrieve the proper sequence of cues necessary for remedial or free choice review.

Item Definition

C1 From Cue ID, To Cue ID—(refer to Cue Director Matrix for a description of cue ID contents.) Designates the sequence of Q9's (beginning and end) utilized for review.

C2 Set Indicator—one of the 25 regularly defined sets.

C3 Subcat Number—defined as 0 for pretest sets; represents each of the 120 subcats for independent and cumulative sets. For post-test set has a range from 1 to 135.

C4 Student Work Classification—the rating of a student's work as excellent, average, good, poor. Pretest and post test sets contain an average work classification.

C5 Actual Sequence, Number of Sequences—Independent sets require one sequence apiece for each work classification, average, good, poor. Cumulative sets require one sequence for good, 2 sequences each for average and poor. Pretest sets require one sequence. Post-test set requires seven sequences.

Table Format

		Student			Actual Sequence	Number of Sequences
From Cue ID	To Cue ID	Indi- cator	Num- ber	Classi- fication		
<u>XXXXXX</u>	<u>XXXXXX</u>	<u>X</u>	<u>YYY</u>	<u>Z</u>	<u>X</u>	<u>X</u>

Note: the X's, Y's and Z represent the number of characters required for each element.

Storage Estimates

Residence: Disk

Type: Permanent

Size: 1370 blocks

Basis of Computation:

(characters per line) (number of sets) (number of subcats) (number of sequences for class) = number of characters

Pretest Sets: 19 (5) (1) (1) = 95 characters

Independent Sets: 19 (13) (120) (3) = 88,920

Cumulative Sets: 19 (6) (120) (5) = 68,400

Post-Test Sets: 19 (1) (135) (7) = 17,955

4.1.4 Cue Director Matrix (CDM)

Function

To pinpoint the disk residence of all compressed cues. As the cues are read in from tape to disk their IDs are stored next to the relative block number within the cue symbol.

### Item Definition

D1      Relative Block Number—location of cue. A count is kept of the number of blocks each cue reserves. Starting with block 0 for the first cue, these counts are summed with the previous total to form the relative block number of the next cue ID.

D2      Cue ID—unique code defining a cue. Composition of code:

- W      The set number. For the learning cues, W stands for each of the 25 regularly defined sets, whereas for instructional cues an artificial set is created to allow uniformity in table structure.
- YY      Type of cue, i.e., 2, 4, 6, 7 . . . 32.
- ZZZ      Frame number. For the learning cues, sequential numbering within set, i.e., 1, 2, 3 . . . For the instructional cues, the first two digits will represent the page number of a multipage cue. The last digit will represent the number of pages.

### Table Format

Relative Block No.	Cue ID
<u>XXXXXX</u>	<u>WYYZZZ</u>

### Storage Estimates

Residence:      Disk  
Type:      Temporary  
Size:      235 Blocks

Basis for Computation:

(number of characters on a line) (maximum number of cues)  
= number of characters.

12 (2500) = 30,000 characters

#### 4.1.5      Cue File Matrix (CFM)

### Function

To describe the basic outline of all compressed cues appearing on tape (and, therefore, on disk).

### Item Definition

E1      Cue ID—identifies each cue. Refer to discussion of Cue Director Matrix

E2      Line Number—designates the line in which the corresponding Information is to appear on display. (Q11 also uses E2 to designate the subcat number in the answer)

E3      Information—contains up to 64 characters of the line data associated with a cue.

Note: Items E1 and E2 each occupy one complete computer word. E3 is composed of 8 computer words. The last E2 for each cue carries an end of cue mark in its word.

### Table Format

Cue ID		
<u>XYZZZZ</u>		
Line Number		Information
<u>XXX</u>		<u>Y<sub>1</sub>Y<sub>2</sub>Y<sub>3</sub>...Y<sub>64</sub></u>

### Storage Estimates

Residence: Tape

Type: Temporary

Size: 20,932 blocks

Basis for Computation:

(characters per line) (number of cues) (number of required lines)  
= number of characters

For Q2, Q6, Q7, Q10, Q12, Q13, 14, 15, 16, 17, 18, 20, 22, 23, 24, 25,  
26, 27, 28, 29, 30, 31, 32

72 (23) (24) = 39,610 characters

The method of ordering sequences all the above instructional cues before any of the following learning cues.

For Q4: 6-page cue totaling 177 lines  
(72) (1) (177) = 12,744

For Q9,  
Q8: 1990 cues, 15 lines each cue  
(72) (1990) (15) = 2,149,200

For Q11: 140 cues, 21 lines each cue  
(72) (140) (21) = 211,680

For Q19: 125 cues, 16 lines each cue  
(72) (125) (16) = 144,000

For Q19A: 125 cues, 13 lines each cue  
(72) (125) (13) = 117,000

For Q21: two-page cue totaling 20 lines  
(72) (1) (20) = 1440

Since there are a number of Q9's (Q8's have same format), Q11's, Q19's, and Q19A's, four areas have been set aside (one for each type) to contain the canned contents of each. They are grouped with the instructional cues.

For Q9: fixed content, 24 lines  
(72) (1) (24) = 1728

For Q11: fixed content, 13 lines  
(72) (1) (13) = 936

For Q19: fixed content, 6 lines  
(72) (1) (6) = 432

For Q19A: fixed content, 5 lines  
(72) (1) (5) = 360

Q1, Q3, Q5, Q33 and Q34 remain on permanent disk.

#### 4.1.6 Criteria Matrix

##### Function

To classify the quality of work achieved by a student in a set as a basis for remedial review.

##### Item Definition

F1 Subcat Rating—a one-character code representing accomplishment: excellent, good, average, poor

F2 Set Type—either cumulative or independent

F3 Error Standard—number of allowable errors for rating

##### Table Format

Subcat Rating	Set Type	Error Standard
<u>X</u>	<u>Y</u>	<u>Z</u>

Storage Estimate

Residence: Disk

Type: Permanent

Size: 1 block

4.1.7 Flex Course Matrix

Function

To allow revisions to the basic design and increase adaptability of the logic to other capabilities.

Item Definition

G1 Pretest Sets—number of such sets in course.

G2 Post-Test Problems—number of problems in course.

G3 Subcat—maximum number of subcats used in the course. Each subcat is defined on Q4.

Table Format

Pretest
Sets
<u>XX</u>
Post-test
Problems
<u>YY</u>
Subcat
<u>ZZZ</u>

Storage Estimates

Residence: Disk

Type: Permanent

Size: 1 block

4.1.8 Summary History Matrix (SHM)

Function

To maintain statistical information on all students regarding their ability and competence.

Item Definition

- H1 Trainee Completion—contains total number of trainees who completed the course material.
- H2 Program Time Group A
- H3 Program Time Group B
- H4 Program Rating Group A
- H5 Program Rating Group B
- H6 Post-Test Rating Group A, First Try
- H7 Post-Test Rating Group A, Final Try
- H8 Post-Test Rating Group B, First Try
- H9 Post-Test Rating Group B, Final Try
- H10(I) Subcat Rating Group A
- H11(I) Subcat Rating Group B
- H12(I) Subcat Rating Post Test

Note: I ranges from 1 to 120, representing the numbers of all the tested subcats.

Storage Estimate

Residence: Disk  
Type: Permanent  
Size: 10 blocks

4.1.9 Additional Data Areas

The following program tables reside on disk and are called in by the capability at execution time. Individual storage requirements are negligible. Only those tables appearing with a (P) after the table name occupy permanent storage.

Tape Call Indicator (P)—indicates availability of the Cue File Matrix. Comprised of a single bit which, when set, indicates that a request to read tape has been issued.

Tape Ready Table (P)—indicates the successful transfer of cues from tape to disk. Each console is assigned an exclusive bit which is set upon program initialization (assuming no malfunction) and reset upon program termination.

Remedial Director Area—contains a given set designator, subcat number, and work classification for eventual operation with the Evaluation Continuation Matrix.

Remedial Sequence Table—contains the remedial sequences (up to 7) as retrieved from the ECM.

Temporary Cue Display Area (TCDA)—receives all cues (except Q1, Q4, A21, and Q34) previous to displaying. Reduces the number of blocks that would otherwise be required if each cue had a different area. For simplicity, the communication program lists all display cues by the number associated with them, e.g., "Display TQ05 and Get Operator Response." In reality, all cues generated from the same area (TCDA) will have the same communications statement, "Display TQXX and Get Operator Response."

Cue Sym Area (P)—contains the symbolic disk addresses of both the Cue File Matrix and Cue Director Matrix.

Response Save Area—saves the trainee's answer to Q9 for redisplay.

#### 4.2 PROGRAM DESCRIPTIONS

This section describes the programs necessary to operate the CDT capability. It is suggested that this be read in conjunction with Section 4.3 (communications program listing) and Appendix C (detailed procedural flow charts) to fully appreciate the program operation and sequence of events leading up to or from a particular program.

SP001—checks validity of entered name and serial number. If nonexistent, error message 3 (see Op Spec) is added to Q5, which is then redisplayed. Returns are made for (1) illegal name or serial number, (2) delete option request, (3) individual trainee request.

SP002—uses name and serial number obtained from Q5 to locate a student's record (within SHM) and clears that area of all data. Area immediately becomes available for the next new trainee entering the system.

WP003—performs updating procedures as instructed by the header and support cards (see Section 3.3). If an error is encountered due to either a card read operation or an incorrectly structured card, error message 2 (see Op Spec) is added to Q3 for redisplay. If tapes are required and are not available, or if some tape operation has been unable to succeed, error message 1 (see Op Spec) is added to Q3. Returns are made for (1) card or tape error (2) completion of updating.

SP004—inspects the Tape Call Indicator (TCI). An "off" condition (implies prior tape call) directs indicator setting and return of control. An "on" condition (bit set) directs program scrutiny of the Tape Ready Table (TRT). Any previous initialization of this table will cause the corresponding console bit to be set. Returns are made for (1) TCI set, TRT not set. (2) TCI set, TRT set.

WP005—examines the TRT. A previous setting precipitates activation of the corresponding console bit and program return. Otherwise, the program attempts to read the Cue File Tape. If successful, the cues are placed on disk and the corresponding console bit is turned on. As each compressed cue is assigned a Symbolic Disk Address (SDA), the Cue Director Matrix will be generated listing all cues and their respective SDAs. The program stores the address of the Cue Director Matrix and Cue File Matrix in the Cue Sym Area. If not successful, error message 1 is added to Q33 for redisplay. Returns are made for (1) transfer of cues from tape to disk (2) tape error.

SP006—compares entered subcat number with legal values. If valid, the post-test set designator, subcat number, and average work classification (see ECM data area, Section 4.1.3) are stored in the Remedial Director Area (RDA). Otherwise error message 4 (see Op Spec) is added to Q4 for redisplay. Returns are made for (1) subcat number error (2) legal value.

SP007—after obtaining the value from RDA, scans the ECM for proper remedial sequences. As retrieved, these sequences are stored in the Remedial Sequence Table (RST) for subsequent pickup.

SP008—positions and directs all training sequence review by use of the RST (contains Q9 IDs). Each cue is located (via CDM), formatted, and transferred to the Temporary Cue Display Area (TCDA) along with the canned Q9 contents and the student's response to last Q9 as stored in the Response Save Area. Returns are made for (1) review complete (2) cue ready for display.

SP009—compares the entered name and serial number on Q6 with those in the SHM. A match (implies old trainee, record intact) will cause placement in [A6] of the time on Q6 and a return of control. If no match occurs, an area is processed as the new student's record (uses a vacated segment in SHM or enlarges the SHM symbol). In this new area is stored (1) student's name and serial number (2) begin run time (3) first learning cue in sequence. The Flex Course Matrix is used to determine the number of subcategory positions, and pretest and post-test problems. Returns are to be made for (1) no match, new trainee (2) match, old trainee.

SP010—compares the last exhibited learning cue with the next learning cue in succession. Results inform the program of student's position within the current set. Returns are made for (1) cues in different sets, (2) cues having same type, same set, (3) cues having different types, same set.

SP011—saves student's response to current Q9 in Response Save Area for display on next Q9. The student is thus able to check his answer with the correct answer.

SP012—compares student's answer (to Q9) with correct result (from next Q9), tallys number of errors, and sums this amount with the previous total in [A5 (I)].

SP013—relates the actual number of errors committed by a student with appropriate entry in the Error Matrix (possible number of errors) to form a percent in [A5 (I)]. Returns are made for (1) errors greater than 5 percent (2) errors less than or equal to 5 percent.

SP014—determines pretest set completion. Returns are made for (1) pretest sets complete (2) introductory material not completed.

SP015—places specific set designator, subcat value 0, and average work classification in RDA.

SP016—analyzes by subcat the number of errors as entered on Q11 and places each total in the appropriate row of [A19 (K)]. Returns are made for (1) errors on problem, first try, (2) errors on problem, second try, (3) no errors.

SP017—permits a student to retake a problem by depositing the cue ID from [A9] into [A10].

SP018—sums the corresponding rows of [A19 (K)] with those in [A18 (K)] and clears out column contents of [A19 (K)]. Also resets the try [A12] for next problem.

SP019—determines which phase of the learning process is to be presented to a trainee. If his sequential student number [A1] is odd, he is given remedial material. Otherwise he bypasses the review. Returns are made for (1) trainee in Group A (2) trainee in Group B.

SP020—using the current subcat number as a positioner, retrieves from the proper [A18 (K)] row the number of errors for that subcat. Assigns to both the RDA and first available path site [A21 (L)], (1) subcat number, (2) current set designator, (3) work classification as stipulated in the Criteria Matrix. Returns are made for (1) subcat review complete, (2) subcat excellent, (3) subcat good, (4) subcat average, (5) subcat poor.

SP021—compares student response to Q9 with correct answer from next Q9. An incorrect response results in a reclassification of the student and forces him on to another remedial sequence. Returns are made for (1) correct answer (2) incorrect answer.

SP022—changes work classification in RDA from good to average and moves contents of RDA to next available path site in [A21 (L)].

SP023—determines whether all cumulative and independent sets have been processed. Returns are made for (1) completion, post-test waiting (2) further cumulative and independent set processing.

SP024—converts each item of [A18 (K)] to a percentage using correct entries from the Error Matrix as a divisor and sums these amounts with the corresponding row elements in [A17 (K)].

SP024A—finds the difference between begin run time [A6] and end time as displayed on last cue, and adds this to the amount in [A4]; then puts end time in [A6] and proper continuation point in [A8] (defined by set) and writes the student's record on disk. This program continually updates a student record by set. If a trainee is in the middle of a set and concludes his session incorrectly, the capability will start him at the end of his last completed set.

SP025—places in [A21 (L)] the special five-character code denoting free choice review. Enables the instructor to distinguish between a student's free choice subcat review and remedial review of those subcats presented by program direction.

SP026—verifies entered subcat number. If valid, enters current set and an average work classification in both the RDA and available [A21 (L)] site. Increases the subcat row item of [A20 (K)]. If the subcat number was not valid, error message 4 is attached to first page of Q21 for redisplay. Returns are made for (1) subcat error (2) legal value.

SP026A—same operation as SP026 except for Q4. Whereas on Q21 the only subcats available to the student were those on the previous set, Q4 allows him to choose any or all of the possible course material subcats.

SP027—sums the number of errors in [A19 (K)] and places total in corresponding slot of [A14 (I)].

SP028—examines each [A14 (I)] for errors. Finding some, moves the cue ID associated with that post-test problem to [A10] for presentation of the problem.

SP029—same action as SP027 except for placement in [A15 (I)].

SP030—picks up each entry in [A18 (K)] and checks for errors. If there are any, places subcat number, post-test set designator, and average work classification in both RDA and [A21 (L)]. Returns are made for (1) subcat analysis complete, (2) no errors for subcat, (3) errors on subcat.

SP031—converts each item from [A18 (K)] to a percentage using correct entries from the Error Matrix as divisor. These values now represent the cumulative percent per subcat for post-test problems.

SP032—locates the whereabouts of compressed Q6 via the CDM and retrieves the contents via the CFM. Transfers cue to the TCDA, expanding result to correct display format as defined by each line position.

SP033 through SP054

SP033 same as SP032 except for Q2  
SP034 same as SP032 except for Q22  
SP035 same as SP032 except for Q23  
SP036 same as SP032 except for Q7  
SP037 same as SP032 except for Q13  
SP038 same as SP032 except for Q14  
SP039 same as SP032 except for Q10  
SP040 same as SP032 except for Q12  
SP041 same as SP032 except for Q16  
SP042 same as SP032 except for Q15  
SP043 same as SP032 except for Q17  
SP044 same as SP032 except for Q26  
SP045 same as SP032 except for Q27  
SP046 same as SP032 except for Q25  
SP047 same as SP032 except for Q24  
SP048 same as SP032 except for Q18  
SP049 same as SP032 except for Q20  
SP050 same as SP032 except for Q28  
SP051 same as SP032 except for Q29  
SP052 same as SP032 except for Q30  
SP053 same as SP032 except for Q31  
SP054 same as SP032 except for Q32

SP055—uses the CDM to locate the disk address of Q4 and then obtains the contents of the multipage cue from the Cue File Matrix. Moves result (properly formatted) to unique TCDA.

SP056—transfers the contents of permanent Q5 to TCDA.

SP056A—same as SP056 except for Q3

SP056B—same as SP056 except for Q33

SP057—picking up ID of next Q8 or Q9 in sequence from [A10], locates (via CDM), expands, and moves cue to TCDA along with the canned Q9 contents and the student's response to last Q8 or Q9 (if any). [A9] receives the ID from [A10], which is then updated for the next learning cue ID.

SP058—places in TCDA both the next Q11 to be displayed and the canned Q11 contents (as explained in SP057), storing the problem answers in a temporary area. Updates [A10] and [A9].

SP059—places in TCDA the next Q19 (refer to SP057), updating [A10] and [A9].

SP060—places in TCDA both the next Q19A and the student's response to the last Q19. Updates [A10] and [A9].

SP061—using the CDM to locate compressed Q21 (both pages), expands the cue and moves it to a special reserve area. All subcats utilized in previous problem set are then placed in this area along with their ratings. Depending upon the number of subcats, one or both pages of the cue is (are) moved to a temporary display area.

SP062 through SP081

SP062 places 1 in continuation point [A8] of SHM  
SP063 places 3 in continuation point [A8] of SHM  
SP064 places 5 in continuation point [A8] of SHM  
SP065 places 6 in continuation point [A8] of SHM  
SP066 places 7 in continuation point [A8] of SHM  
SP067 places 8 in continuation point [A8] of SHM  
SP068 places 11 in continuation point [A8] of SHM  
SP069 places 13 in continuation point [A8] of SHM  
SP070 places 14 in continuation point [A8] of SHM  
SP071 places 15 in continuation point [A8] of SHM  
SP072 places 17 in continuation point [A8] of SHM  
SP073 places 21 in continuation point [A8] of SHM  
SP074 places 22 in continuation point [A8] of SHM  
SP075 places 23 in continuation point [A8] of SHM  
SP076 places 24 in continuation point [A8] of SHM  
SP077 places 25 in continuation point [A8] of SHM  
SP078 places 26 in continuation point [A8] of SHM  
SP079 places 28 in continuation point [A8] of SHM  
SP080 places 32 in continuation point [A8] of SHM  
SP081 places 34 in continuation point [A8] of SHM

SP085 through SP095

SP085 moves ID from [A9] to [A10] and places 2 in [A8]  
SP086 moves ID from [A9] to [A10] and places 4 in [A8]  
SP087 moves ID from [A9] to [A10] and places 9 in [A8]  
SP088 moves ID from [A9] to [A10] and places 12 in [A8]  
SP089 moves ID from [A9] to [A10] and places 18 in [A8]  
SP090 moves ID from [A9] to [A10] and places 19 in [A8]  
SP091 moves ID from [A9] to [A10] and places 27 in [A8]  
SP092 moves ID from [A9] to [A10] and places 29 in [A8]  
SP093 moves ID from [A9] to [A10] and places 33 in [A8]  
SP094 reduces subcat number in [A11] by 1 and places a 16 in [A8]  
SP095 reduces subcat number in [A11] by 1 and places a 31 in [A8]

SP096—goes to the Tape Ready Table, deactivates the related console bit, and then examines the table for other settings. Finding none, deallocates the disk symbol containing the compressed cues and resets the Tap Call Indicator.

Also finds the difference between the time in [A6] and that on the last displayed cue, adding result to [A4]. Lastly, writes the students record on disk. If, upon examination of the table, other settings are found, all of the above except deallocation of the disk symbol would take place.

SP097—returns old trainee to proper starting point. An adjustment counter (equation  $10X + 1$ ) is kept in a temporary area to match on the continuation point [A8]. Each time through the program, X is increased by 1 (starts with  $X = 0$ ).

SP098—uses CDM to locate set of post-test set problems (Q11). As each is picked up, it is formatted and placed in TCDA along with the canned Q11 subject matter. Returns are made for (1) end of post-test problems (2) post-test problem ready for display.

WPPRT1—counts the number of trainees still in progress. Outputs content of Summary History Matrix on line printer. Refer to Op Spec, printout 1 for format.

WPPRT2—retrieves from the SHM the requested student record and, depending upon his progress, moves those items containing a completed set's data to an area for printout 2.

WPPRT3—outputs the student's response to Q19 on printout 3. Also stores this response for movement to Q19A.

WPPRT4—picks up from Q11 the student's answers to post-test problems and outputs them on printout 4.

WPUPD5—updates the Summary History Matrix with the student's record, prints out his record on the line printer, and clears the area for assignment to a new trainee.

WPPRT5—transfers to the line printer the contents of the Cue File Matrix. This allows the instructor to periodically review the contents of this matrix for possible updating (as described in Section 3.3). Since the CFM is on tape, it is assumed that the instructor had requested mounting the tape prior to pushing the Cue File Matrix button. If this is not so, and the tape is not ready when the read tape command is issued, error message 1 will be generated on Q3.

WPPRT6—outputs on line printer the contents of the Criteria Matrix.

WPPRT7—outputs on line printer the contents of Evaluation Continuation Matrix.

WPPRT8—outputs contents of Error Matrix.

WPPRT9—outputs contents of Flex Course Matrix.

#### 4.3 COMMUNICATIONS PROGRAM LISTING

This section lists the program steps necessary to operate the CDT capability.

```
01 DISPLAY Q1 AND GET OPERATOR RESPONSE
  IF L03 DO A1
  IF L01 DO A1
  IF L02 DO C1
C1 OPERATE SP056A THEN DO 1C
1C DISPLAY TQ03 AND GET OPERATOR RESPONSE
  IF L07 DO C9
  IF L08 DO C8
  IF L09 DO C7
  IF L13 DO 65
  IF L14 DO 66
  IF L15 DO 67
  IF L16 DO 68
  IF L17 DO 69
65 OPERATE WPPRT8 THEN DO 1C
66 OPERATE WPPRT7 THEN DO 1C
67 OPERATE WPPRT5 THEN DO 1C
68 OPERATE WPPRT6 THEN DO 1C
69 OPERATE WPPRT9 THEN DO 1C
C9 OPERATE WPPRT1 THEN DO 1C
C8 OPERATE SP056 THEN DO 8C
8C DISPLAY TQ05 AND GET OPERATOR RESPONSE
  IF ENTER DO 02
02 OPERATE SP001 THEN DO OPTIONS
  IF RETURN 1 DO 8C
  IF RETURN 2 DO 9C
  IF RETURN 3 DO 5C
9C OPERATE SP002 THEN DO C1
5C OPERATE WPPRT2 THEN DO C1
C7 OPERATE WP003 THEN DO OPTIONS
  IF RETURN 1 DO 1C
  IF RETURN 2 DO 7C
7C DISPLAY O34 AND GET OPERATOR RESPONSE
  IF ENTER DO C1
A1 OPERATE SP004 THEN DO OPTIONS
  IF RETURN 1 DO F1
  IF RETURN 2 DO A2
F1 OPERATE SP056B THEN DO F2
F2 DISPLAY TQ33 AND GET OPERATOR RESPONSE
  IF L25 DO F3
F3 OPERATE WP005 THEN DO OPTIONS
```

IF RETURN 1 DO A2  
IF RETURN 2 DO F2  
A2 OPERATE SP032 THEN DO F4  
F4 DISPLAY TQ06 AND GET OPERATOR RESPONSE  
IF ENTER DO A3  
A3 IF L03 IS SET DO A4  
ELSE DO B1  
A4 OPERATE SP033 THEN DO F5  
F5 DISPLAY TQ02 AND GET OPERATOR RESPONSE  
IF L11 DO G1  
IF L10 DO A5  
IF L29 DO 04  
04 OPERATE SP054 THEN DO 05  
05 DISPLAY TQ32 AND GET OPERATOR RESPONSE  
IF ENTER DO 05  
A5 OPERATE SP055 THEN DO A6  
A6 DISPLAY TQ04 AND GET OPERATOR RESPONSE  
IF L29 DO 04  
IF ENTER DO 06  
06 OPERATE SP006 THEN DO OPTIONS  
IF RETURN 1 DO A6  
IF RETURN 2 DO A7  
A7 OPERATE SP034 THEN DO F6  
F6 DISPLAY TQ22 AND GET OPERATOR RESPONSE  
IF L29 DO 04  
IF L25 DO A8  
A8 OPERATE SP007 THEN DO F7  
F7 OPERATE SP008 THEN DO OPTIONS  
IF RETURN 1 DO F8  
IF RETURN 2 DO A9  
A9 DISPLAY TQ09 AND GET OPERATOR RESPONSE  
IF L29 DO 04  
IF L27 DO F8  
IF ENTER DO 07  
07 OPERATE SP011 THEN DO F7  
F8 OPERATE SP049 THEN DO F9  
F9 DISPLAY TQ20 AND GET OPERATOR RESPONSE  
IF L10 DO A5  
IF L25 DO A4  
IF L29 DO 04  
G1 OPERATE SP050 THEN DO 71  
71 DISPLAY TQ28 AND GET OPERATOR RESPONSE  
IF L25 DO 72  
IF L29 DO 04  
72 OPERATE SP098 THEN DO OPTIONS  
IF RETURN 1 DO A4  
IF RETURN 2 DO G2

```
G2 DISPLAY TQ11 AND GET OPERATOR RESPONSE
IF L29 DO 04
IF ENTER DO 72
B1 OPERATE SP009 THEN DO OPTIONS
IF RETURN 1 DO B2
IF RETURN 2 DO G3
G3 OPERATE SP097 THEN DO OPTIONS
IF RETURN 1 DO B2
IF RETURN 2 DO B3
IF RETURN 3 DO B4
IF RETURN 4 DO B5
IF RETURN 5 DO B8
IF RETURN 6 DO B7
IF RETURN 7 DO B7
IF RETURN 8 DO D1
IF RETURN 9 DO J7
IF RETURN 10 DO G4
G4 OPERATE SP097 THEN DO OPTIONS
IF RETURN 1 DO D2
IF RETURN 2 DO K3
IF RETURN 3 DO D4
IF RETURN 4 DO D5
IF RETURN 5 DO D6
IF RETURN 6 DO L2
IF RETURN 7 DO N3
IF RETURN 8 DO N5
IF RETURN 9 DO N8
IF RETURN 10 DO G5
G5 OPERATE SP097 THEN DO OPTIONS
IF RETURN 1 DO P2
IF RETURN 2 DO P8
IF RETURN 3 DO R8
IF RETURN 4 DO R8
IF RETURN 5 DO R8
IF RETURN 6 DO E1
IF RETURN 7 DO 21
IF RETURN 8 DO E2
IF RETURN 9 DO E3
IF RETURN 10 DO G6
G6 OPERATE SP097 THEN DO OPTIONS
IF RETURN 1 DO E7
IF RETURN 2 DO 34
IF RETURN 3 DO 36
IF RETURN 4 DO 57
B2 OPERATE SP036 THEN DO G7
G7 DISPLAY TQ07 AND GET OPERATOR RESPONSE
IF L29 DO T1
IF ENTER DO G8
```

G8 OPERATE SP010 THEN DO OPTIONS  
IF RETURN 1 DO B3  
IF RETURN 2 DO B3  
IF RETURN 3 DO B4  
B3 OPERATE SP057 THEN DO G9  
G9 DISPLAY TQ09 AND GET OPERATOR RESPONSE  
IF L29 DO T2  
IF ENTER DO H1  
H1 OPERATE SP011 THEN DO G8  
B4 OPERATE SP039 THEN DO H2  
H2 DISPLAY TQ10 AND GET OPERATOR RESPONSE  
IF L29 DO T3  
IF L25 DO B5  
B5 OPERATE SP057 THEN DO H3  
H3 DISPLAY TQ09 AND GET OPERATOR RESPONSE  
IF L29 DO T4  
IF ENTER DO H4  
H4 OPERATE SP011 THEN DO H5  
H5 OPERATE SP012 THEN DO H6  
H6 OPERATE SP010 THEN DO OPTIONS  
IF RETURN 1 DO B6  
IF RETURN 2 DO B5  
B6 OPERATE SP013 THEN DO OPTIONS  
IF RETURN 1 DO B7  
IF RETURN 2 DO B8  
B8 OPERATE SP037 THEN DO H7  
H7 DISPLAY TQ13 AND GET OPERATOR RESPONSE  
IF L29 DO T5  
IF L25 DO B9  
B9 OPERATE SP024A THEN DO H8  
H8 OPERATE SP014 THEN DO OPTIONS  
IF RETURN 1 DO D1  
IF RETURN 2 DO B2  
B7 OPERATE SP040 THEN DO H9  
H9 DISPLAY TQ12 AND GET OPERATOR RESPONSE  
IF L29 DO T6  
IF L25 DO J1  
J1 OPERATE SP015 THEN DO J2  
J2 OPERATE SP007 THEN DO J3  
J3 OPERATE SP008 THEN DO OPTIONS  
IF RETURN 1 DO B9  
IF RETURN 2 DO J4  
J4 DISPLAY TQ09 AND GET OPERATOR RESPONSE  
IF L29 DO T7  
IF ENTER DO J5  
J5 OPERATE SP011 THEN DO J3  
D1 OPERATE SP036 THEN DO J6

J6 DISPLAY TQ07 AND GET OPERATOR RESPONSE  
IF L29 DO T8  
IF ENTER DO J7  
J7 OPERATE SP057 THEN DO J8  
J8 DISPLAY TQ09 AND GET OPERATOR RESPONSE  
IF L29 DO T9  
IF ENTER DO J9  
J9 OPERATE SP011 THEN DO K1  
K1 OPERATE SP010 THEN DO OPTIONS  
IF RETURN 2 DO J7  
IF RETURN 3 DO D2  
D2 OPERATE SP038 THEN DO K2  
K2 DISPLAY TQ14 AND GET OPERATOR RESPONSE  
IF L29 DO V1  
IF L25 DO K3  
K3 OPERATE SP058 THEN DO K4  
K4 DISPLAY TQ11 AND GET OPERATOR RESPONSE  
IF L29 DO V2  
IF ENTER DO K5  
K5 OPERATE SP016 THEN DO OPTIONS  
IF RETURN 1 DO D4  
IF RETURN 2 DO D5  
IF RETURN 3 DO D6  
D4 OPERATE SP041 THEN DO K6  
K6 DISPLAY TQ16 AND GET OPERATOR RESPONSE  
IF L29 DO V3  
IF L12 DO D7  
IF L25 DO D8  
D7 OPERATE SP017 THEN DO K3  
D5 OPERATE SP043 THEN DO K7  
K7 DISPLAY TQ17 AND GET OPERATOR RESPONSE  
IF L29 DO V4  
IF L25 DO D8  
D6 OPERATE SP042 THEN DO K8  
K8 DISPLAY TQ15 AND GET OPERATOR RESPONSE  
IF L29 DO V5  
IF L25 DO D8  
D8 OPERATE SP018 THEN DO K9  
K9 OPERATE SP010 THEN DO OPTIONS  
IF RETURN 2 DO K3  
IF RETURN 3 DO L1  
L1 OPERATE SP019 THEN DO OPTIONS  
IF RETURN 1 DO L2  
IF RETURN 2 DO N3  
L2 OPERATE SP020 THEN DO OPTIONS  
IF RETURN 1 DO N3  
IF RETURN 2 DO L2

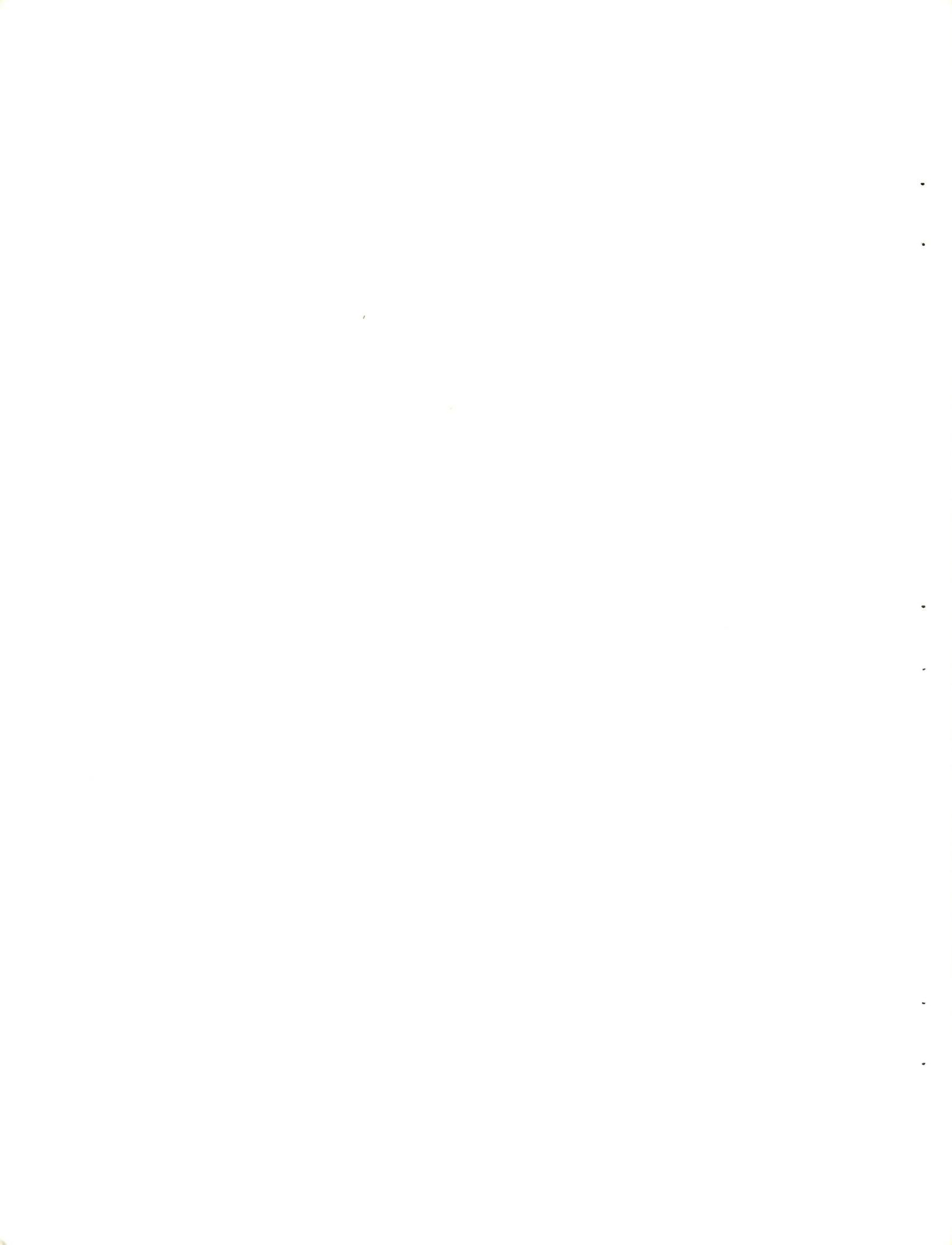
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    IF RETURN 3 DO L3
    IF RETURN 4 DO M4
    IF RETURN 5 DO N1
L3  OPERATE SP044 THEN DO L4
L4  DISPLAY TQ26 AND GET OPERATOR RESPONSE
    IF L29 DO V6
    IF L25 DO L5
L5  OPERATE SP007 THEN DO L6
L6  OPERATE SP008 THEN DO OPTIONS
    IF RETURN 1 DO L9
    IF RETURN 2 DO L7
L7  DISPLAY TQ09 AND GET OPERATOR RESPONSE
    IF L29 DO V6
    IF ENTER DO L8
L8  OPERATE SP011 THEN DO L6
L9  OPERATE SP021 THEN DO OPTIONS
    IF RETURN 1 DO L2
    IF RETURN 2 DO M1
M1  OPERATE SP045 THEN DO M2
M2  DISPLAY TQ27 AND GET OPERATOR RESPONSE
    IF L29 DO V6
    IF L25 DO M3
M3  OPERATE SP022 THEN DO M4
M4  OPERATE SP046 THEN DO M5
M5  DISPLAY TQ25 AND GET OPERATOR RESPONSE
    IF L29 DO V6
    IF L25 DO M6
M6  OPERATE SP007 THEN DO M7
M7  OPERATE SP008 THEN DO OPTIONS
    IF RETURN 1 DO L2
    ID RETURN 2 DO M8
M8  DISPLAY TQ09 AND GET OPERATOR RESPONSE
    IF L29 DO V6
    IF ENTER DO M9
M9  OPERATE SP011 THEN DO M7
N1  OPERATE SP047 THEN DO N2
N2  DISPLAY TQ24 AND GET OPERATOR RESPONSE
    IF L29 DO V6
    IF L25 DO M6
N3  OPERATE SP048 THEN DO N4
N4  DISPLAY TQ18 AND GET OPERATOR RESPONSE
    IF L25 DO N5
    IF L29 DO V7
N5  OPERATE SP059 THEN DO N6
N6  DISPLAY TQ19 AND GET OPERATOR RESPONSE
    IF L29 DO V8
    IF ENTER DO N7
```

N7 OPERATE WPPRT3 THEN DO N8  
N8 OPERATE SP060 THEN DO N9  
N9 DISPLAY TQ19A AND GET OPERATOR RESPONSE  
  IF L29 DO V9  
  IF L25 DO P1  
P1 OPERATE SP010 THEN DO OPTIONS  
  IF RETURN 1 DO P2  
  IF RETURN 3 DO N5  
P2 OPERATE SP049 THEN DO P3  
P3 DISPLAY TQ20 AND GET OPERATOR RESPONSE  
  IF L29 DO X1  
  IF L25 DO P4  
  IF L10 DO P7  
P4 OPERATE SP024 THEN DO P5  
P5 OPERATE SP024A THEN DO P6  
P6 OPERATE SP023 THEN DO OPTIONS  
  IF RETURN 1 DO E1  
  IF RETURN 2 DO D1  
P7 OPERATE SP025 THEN DO P8  
P8 OPERATE SP061 THEN DO P9  
P9 DISPLAY TQ21 AND GET OPERATOR RESPONSE  
  IF L29 DO X2  
  IF ENTER DO R1  
R1 OPERATE SP026 THEN DO OPTIONS  
  IF RETURN 1 DO P9  
  IF RETURN 2 DO R2  
R2 OPERATE SP034 THEN DO R3  
R3 DISPLAY TQ22 AND GET OPERATOR RESPONSE  
  IF L29 DO X3  
  IF L25 DO R4  
R4 OPERATE SP007 THEN DO R5  
R5 OPERATE SP008 THEN DO OPTIONS  
  IF RETURN 1 DO R8  
  IF RETURN 2 DO R6  
R6 DISPLAY TQ09 AND GET OPERATOR RESPONSE  
  IF L29 DO X4  
  IF L27 DO R8  
  IF ENTER DO R7  
R7 OPERATE SP011 THEN DO R5  
R8 OPERATE SP049 THEN DO R9  
R9 DISPLAY TQ20 AND GET OPERATOR RESPONSE  
  IF L29 DO X5  
  IF L10 DO P8  
  IF L25 DO P4  
E1 OPERATE SP036 THEN DO 20  
20 DISPLAY TQ07 AND GET OPERATOR RESPONSE  
  IF L29 DO X6  
  IF ENTER DO 21

21 OPERATE SP057 THEN DO 22  
22 DISPLAY TQ09 AND GET OPERATOR RESPONSE  
IF L29 DO X7  
IF ENTER DO 23  
23 OPERATE SP011 THEN DO 24  
24 OPERATE SP010 THEN DO OPTIONS  
IF RETURN 2 DO 21  
IF RETURN 3 DO E2  
E2 OPERATE SP050 THEN DO 25  
25 DISPLAY TQ28 AND GET OPERATOR RESPONSE  
IF L29 DO X8  
IF L25 DO E3  
E3 OPERATE SP058 THEN DO 26  
26 DISPLAY TQ11 AND GET OPERATOR RESPONSE  
IF L29 DO X9  
IF ENTER DO 27  
27 OPERATE WPPRT4 THEN DO E4  
E4 OPERATE SP016 THEN DO OPTIONS  
IF RETURN 1 DO E5  
IF RETURN 2 DO E5  
E5 OPERATE SP027 THEN DO 28  
28 OPERATE SP018 THEN DO E6  
E6 OPERATE SP010 THEN DO OPTIONS  
IF RETURN 1 DO E7  
IF RETURN 2 DO E3  
E7 OPERATE SP030 THEN DO OPTIONS  
IF RETURN 1 DO 33  
IF RETURN 2 DO E7  
IF RETURN 3 DO E8  
E8 OPERATE SP051 THEN DO 29  
29 DISPLAY TQ29 AND GET OPERATOR RESPONSE  
IF L29 DO Y1  
IF L25 DO E9  
E9 OPERATE SP007 THEN DO 30  
30 OPERATE SP008 THEN DO OPTIONS  
IF RETURN 1 DO E7  
IF RETURN 2 DO 31  
31 DISPLAY TQ09 AND GET OPERATOR RESPONSE  
IF L29 DO Y1  
IF ENTER DO 32  
32 OPERATE SP011 THEN DO 30  
33 OPERATE SP028 THEN DO OPTIONS  
IF RETURN 1 DO 41  
IF RETURN 2 DO 34  
34 OPERATE SP052 THEN DO 35  
35 DISPLAY TQ30 AND GET OPERATOR RESPONSE  
IF L29 DO Y2  
IF L25 DO 36

36 OPERATE SP058 THEN DO 37  
37 DISPLAY TQ11 AND GET OPERATOR RESPONSE  
IF L29 DO Y3  
IF ENTER DO 38  
38 OPERATE WPPRT4 THEN DO 39  
39 OPERATE SP016 THEN DO OPTIONS  
IF RETURN 1 DO 40  
IF RETURN 3 DO 40  
40 OPERATE SP029 THEN DO 33  
41 OPERATE SP035 THEN DO 42  
42 DISPLAY TQ23 AND GET OPERATOR RESPONSE  
IF L25 DO 43  
IF L10 DO 47  
43 OPERATE SP031 THEN DO 44  
44 OPERATE SP053 THEN DO 45  
45 DISPLAY TQ31 AND REQUEST WPUPD5 AND GET OPERATOR RESPONSE  
IF ENTER DO 46  
46 DISPLAY TQ31 AND GET OPERATOR RESPONSE  
IF ENTER DO 46  
47 OPERATE SP025 THEN DO 48  
48 OPERATE SP055 THEN DO 49  
49 DISPLAY TQ04 AND GET OPERATOR RESPONSE  
IF L29 DO Y4  
IF ENTER DO 50  
50 OPERATE SP026A THEN DO OPTIONS  
IF RETURN 1 DO 49  
IF RETURN 2 DO 51  
51 OPERATE SP034 THEN DO 52  
52 DISPLAY TQ22 AND GET OPERATOR RESPONSE  
IF L29 DO Y4  
IF L25 DO 53  
53 OPERATE SP007 THEN DO 54  
54 OPERATE SP008 THEN DO OPTIONS  
IF RETURN 1 DO 57  
IF RETURN 2 DO 55  
55 DISPLAY TQ09 AND GET OPERATOR RESPONSE  
IF L29 DO Y4  
IF L27 DO 57  
IF ENTER DO 56  
56 OPERATE SP011 THEN DO 54  
57 OPERATE SP035 THEN DO 58  
58 DISPLAY TQ23 AND GET OPERATOR RESPONSE  
IF L25 DO 43  
IF L10 DO 48  
T1 OPERATE SP062 THEN DO 59  
59 OPERATE SP096 THEN DO 60  
60 OPERATE SP054 THEN DO 61

```
61 DISPLAY TQ32 AND GET OPERATOR RESPONSE
  IF ENTER DO 61
T2 OPERATE SP085 THEN DO 59
T3 OPERATE SP063 THEN DO 59
T4 OPERATE SP086 THEN DO 59
T5 OPERATE SP064 THEN DO 59
T6 OPERATE SP065 THEN DO 59
T7 OPERATE SP066 THEN DO 59
T8 OPERATE SP067 THEN DO 59
T9 OPERATE SP087 THEN DO 59
V1 OPERATE SP068 THEN DO 59
V2 OPERATE SP088 THEN DO 59
V3 OPERATE SP069 THEN DO 59
V4 OPERATE SP070 THEN DO 59
V5 OPERATE SP071 THEN DO 59
V6 OPERATE SP094 THEN DO 59
V7 OPERATE SP072 THEN DO 59
V8 OPERATE SP089 THEN DO 59
V9 OPERATE SP090 THEN DO 59
X1 OPERATE SP073 THEN DO 59
X2 OPERATE SP074 THEN DO 59
X3 OPERATE SP075 THEN DO 59
X4 OPERATE SP076 THEN DO 59
X5 OPERATE SP077 THEN DO 59
X6 OPERATE SP078 THEN DO 59
X7 OPERATE SP091 THEN DO 59
X8 OPERATE SP079 THEN DO 59
X9 OPERATE SP092 THEN DO 59
Y1 OPERATE SP095 THEN DO 59
Y2 OPERATE SP080 THEN DO 59
Y3 OPERATE SP093 THEN DO 59
Y4 OPERATE SP081 THEN DO 59
```



**Appendix A**

**SYSTEM 473L**



## SYSTEM 473L

System 473L is the Headquarters United States Air Force Command and Control System located in the Air Force Command Post at the Pentagon. It is an on-line, real-time information processing system designed to facilitate effective management of USAF resources, particularly during emergency situations, through the accomplishment of several general functions.

These functions are basic to the discharge of command responsibilities, regardless of the specific military service or level of command being addressed. In System 473L, each of these functions is supported by one or more specific operational capabilities; that is, by a set of interrelated computer programs designed to provide a console operator with information relative to significant and predefined operational problems encountered in the exercise of USAF responsibilities. The total set of operational capabilities provides for the retrieval of information relative to the current status of USAF resources on a world-wide basis.

As may already be apparent, one area critical to the effectiveness of systems of this nature is that of man-computer communication. This communication may be effected in many ways, ranging from a simple input/output typewriter to a sophisticated operator console. The major features may include both a black and white and a multicolor display, electronic typewriter, a logic keyboard (an input device using pushbuttons and key-identifying overlays), and a console printer. A photographic device used to provide a permanent reproduction of the displays may also be included. All these features are incorporated in the 473L Integrated Console, from which Air Staff decision-makers use the operational capabilities as required. Operational capabilities are exercised via operational capability overlays; that is, via plastic masks fitting over the logic keyboard portion of the operator console. To the computer, the mask delineates the set of programs associated with a particular operational capability. To the operator, the mask indicates decision alternatives and procedures unique to the capability. There is one overlay corresponding to each operational capability.

Operation via the overlay provides, upon activation of logic pushbuttons, an indication of which pushbuttons may legally be activated next, presents a cue message on a display to advise the operator of the actions available to him, allows alphanumeric data to be entered to complete a cue message, and responds to the completed cue message by displaying a follow-on cue message or a data output. In this way, the operator is led step by step through the procedures necessary to obtain the desired information. This kind of man-computer communication is sometimes referred to as a "conversational mode."

A second method of communication between the system operator and the data processing subsystem is via the Query Language. This is a quasi-English language which allows the operator maximum freedom in selecting specific items and amounts of information from the system data base. It provides the ability to respond to a variety of very specific and unanticipated operational questions. The Query Language thus complements the capability overlay method of communication, which was designed to respond in a flexible, but predetermined manner to a significant portion of an operational situation.

In using the Query Language, the operator enters his query directly by means of the typewriter portion of the operator console. The Query Language program interprets the statement, makes the desired retrieval, and formats the output. In addition to direct retrieval, the Query Language includes the following functions:

1. Computation, such as summing numerical values.
2. Logical operations, such as finding largest or smallest values.
3. Sorting retrieval data for output.
4. Manipulating files to combine parts of two files into one.
5. Storing and recalling frequently used query statements.

The Query Language can also be used as a tool for system programmers in that it permits a sequence of operationally related statements to be processed as a group, has powerful file reorganization capabilities, and has variable output format capabilities.

Since System 473L is on-line with an automatic digital communications system and performs in real-time with local information retrieval/display consoles, a complex operational monitor program is required to maintain master control of operations being performed. This program must recognize priorities, administer queues, call in special routines and tables, maintain duplicate data bases, provide techniques for memory protection and memory allocation, and manipulate control as a function of system load and equipment availability.

The operational monitor program, residing permanently in core memory, is composed of several self-contained programs such as an input/output program, a storage access/allocation program, and a loader program. The operation of these programs and all others in the system is controlled through mechanism of system interrupts or program requests. All the control and operating programs adhere to an integrated relationship to ensure that the parallel processing features of the system do not interfere with each other.

**Appendix B**

**473L PROGRAM DEFINITIONS**



## 473L PROGRAM DEFINITIONS

### CAPABILITY PROGRAMS

The set of programs designed to perform the calculations and data manipulation called for in an Operational Specification is designated as a capability program.

The set is divided into three groups classified as working, service and communication programs. When a working program is being executed, the capability program is said to be operating at the working level. Similarly, a capability program may operate at the service or communication level.

### WORKING PROGRAMS

A working program consists of instructions to the Librascope L-3055 computer. It is loaded into core as a result of a program request step (see Appendix C) and must occupy less than 15000 locations.

When a working program receives control, it is free to call any subprograms necessary for complete operation.

### SERVICE PROGRAMS

A service program has the same characteristics as a working program except that it is intended to provide a means for executing simple tasks on a priority basis. This has resulted in some additional restrictions on the group of service programs.

1. Service programs must not exceed 2000 core locations and must complete execution in under one minute.
2. Service programs must not operate the printer or card reader-punch, and must not seize tapes.

### COMMUNICATION PROGRAMS

Communication programs are written in a special language which is interpreted by the Control Consoles Program of the monitor. These communication

programs permit the capability to set up communication between the user and the capability. Communication programs have three different types of instructions.

1. Program Request Step—This permits the capability to instruct the monitor to load either a working or a service program.
2. Operator Intervention Step—This permits the capability to enable unique console lights and branch according to the operator's action.
3. Logic Key Test Step—This permits the capability to branch on previous actions performed by the operator.

A communication program, then, is a series of steps which cause the operations defined by a detailed procedural flow diagram in an Operational Specification to occur. The steps of a communication program correspond to the groups of symbols comprising the detailed procedural flow diagram.

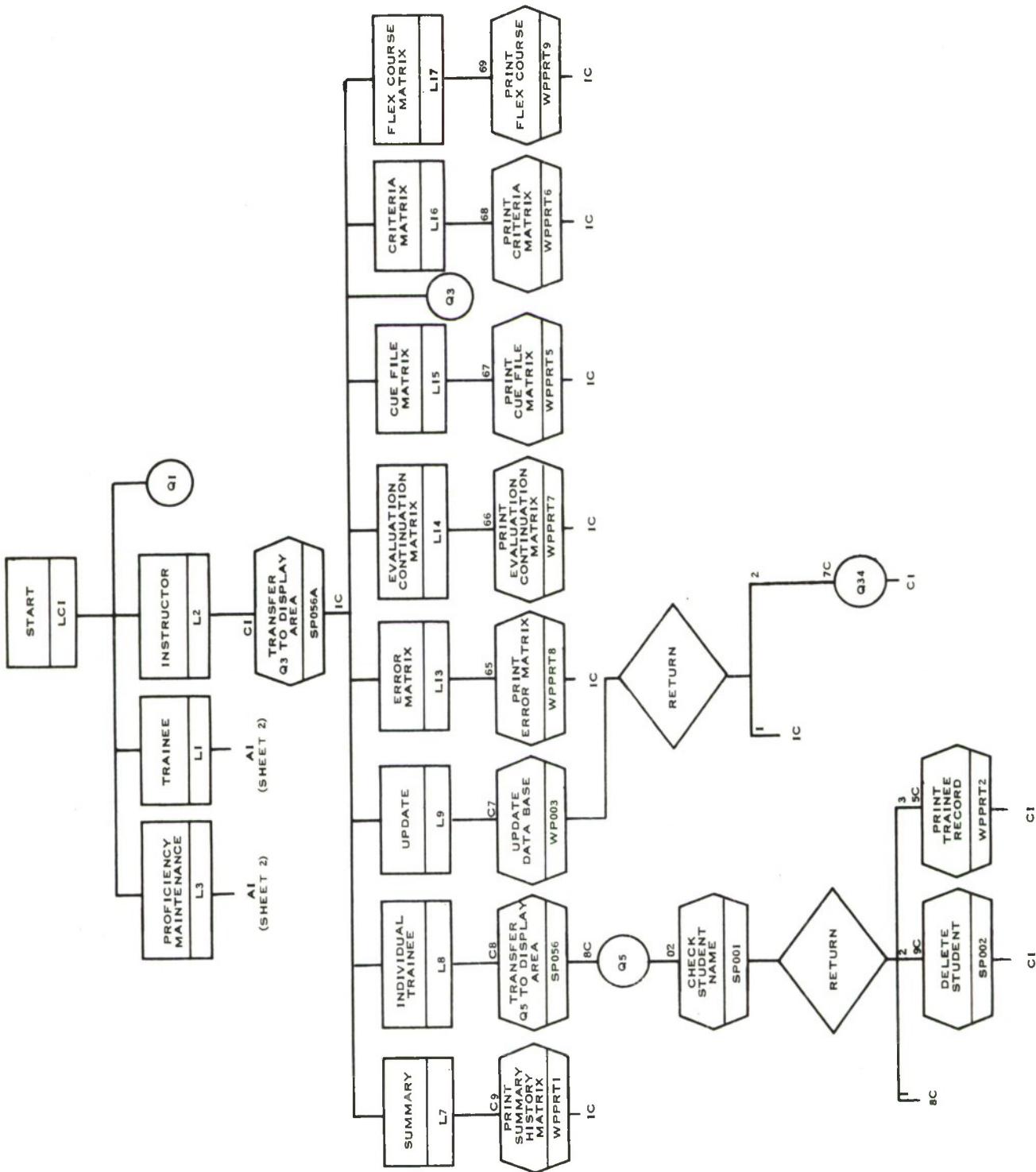
#### COC PROGRAMS

Operational Monitor  
Data Control  
Query Language  
Query Language Overlay  
Exercise and Evaluation  
Data Recording and Reduction  
Multicolor Interpretive Output Processor  
Interpretive Data Processor  
Deployment Monitor  
ACE-Tactical  
Materiel Plan Modification/Evaluation  
Medical Status and Evaluation  
Forces Plan Modification/Evaluation  
Personnel Status and Evaluation  
Communications and Electronics Status and Evaluation  
Plan Data Retrieval  
Resource Characteristics Data Retrieval  
ACE-Transport  
Tactical Rapid Aircraft Capability Estimator  
Overall Plan Evaluation  
Resource Status Data Retrieval

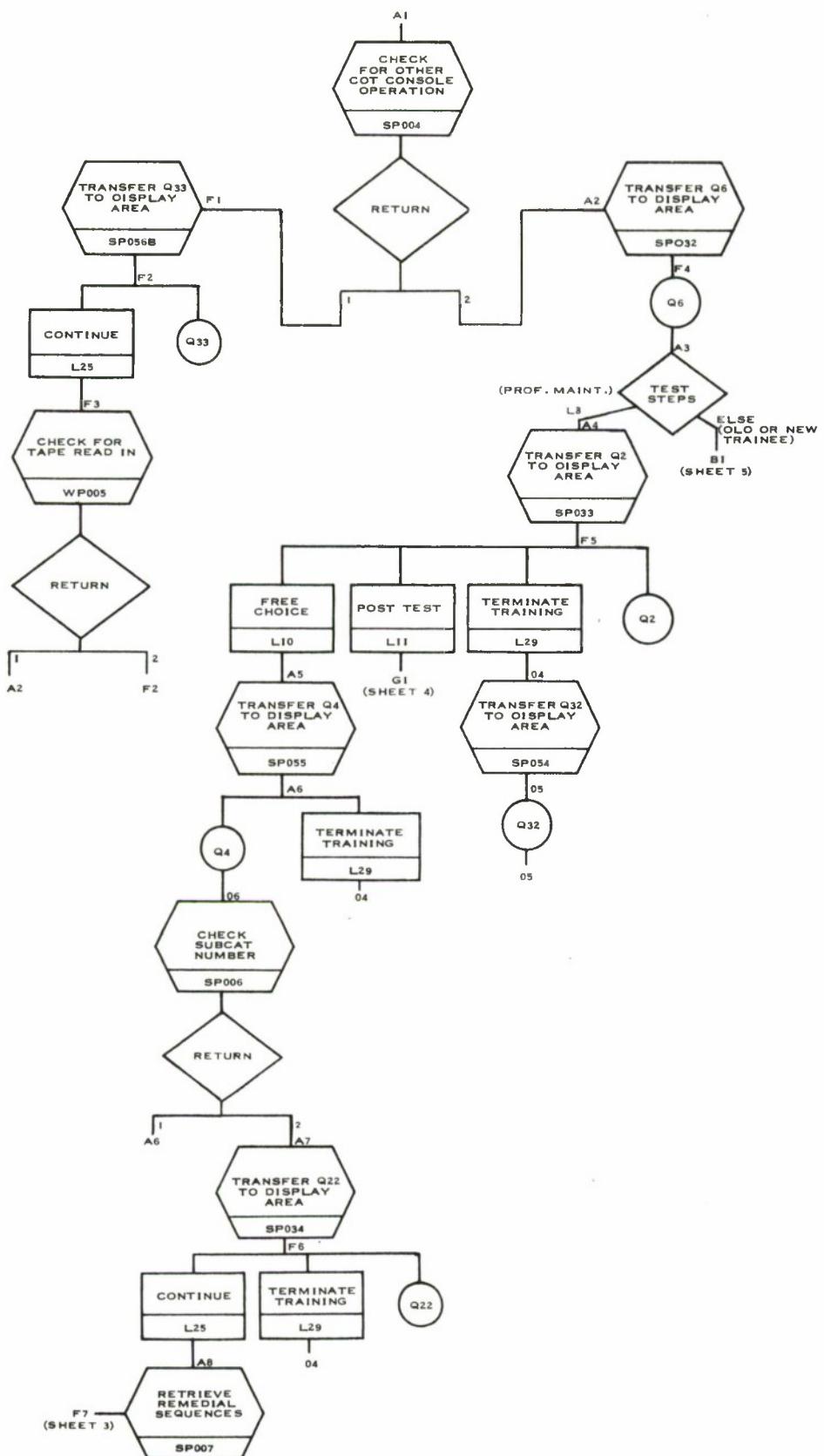
## **Appendix C**

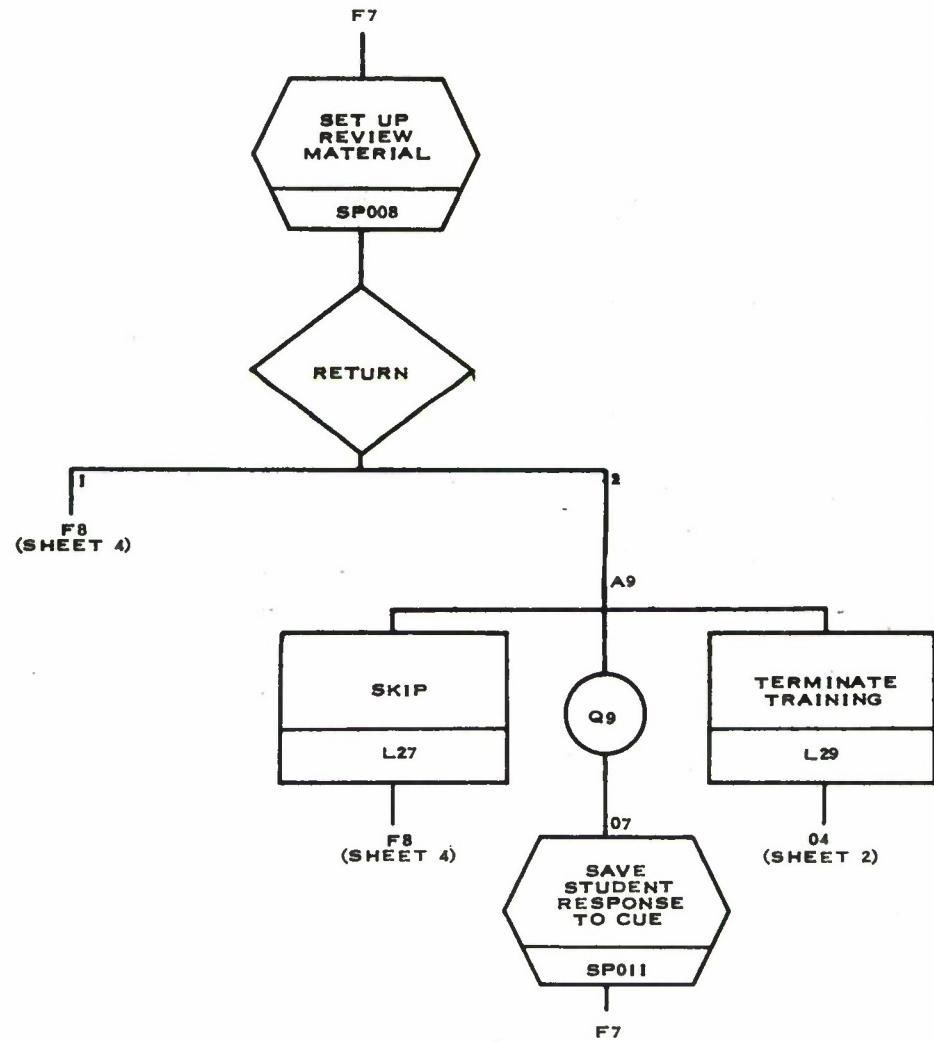
### **COMMUNICATIONS PROGRAM, DETAILED PROCEDURAL FLOW**



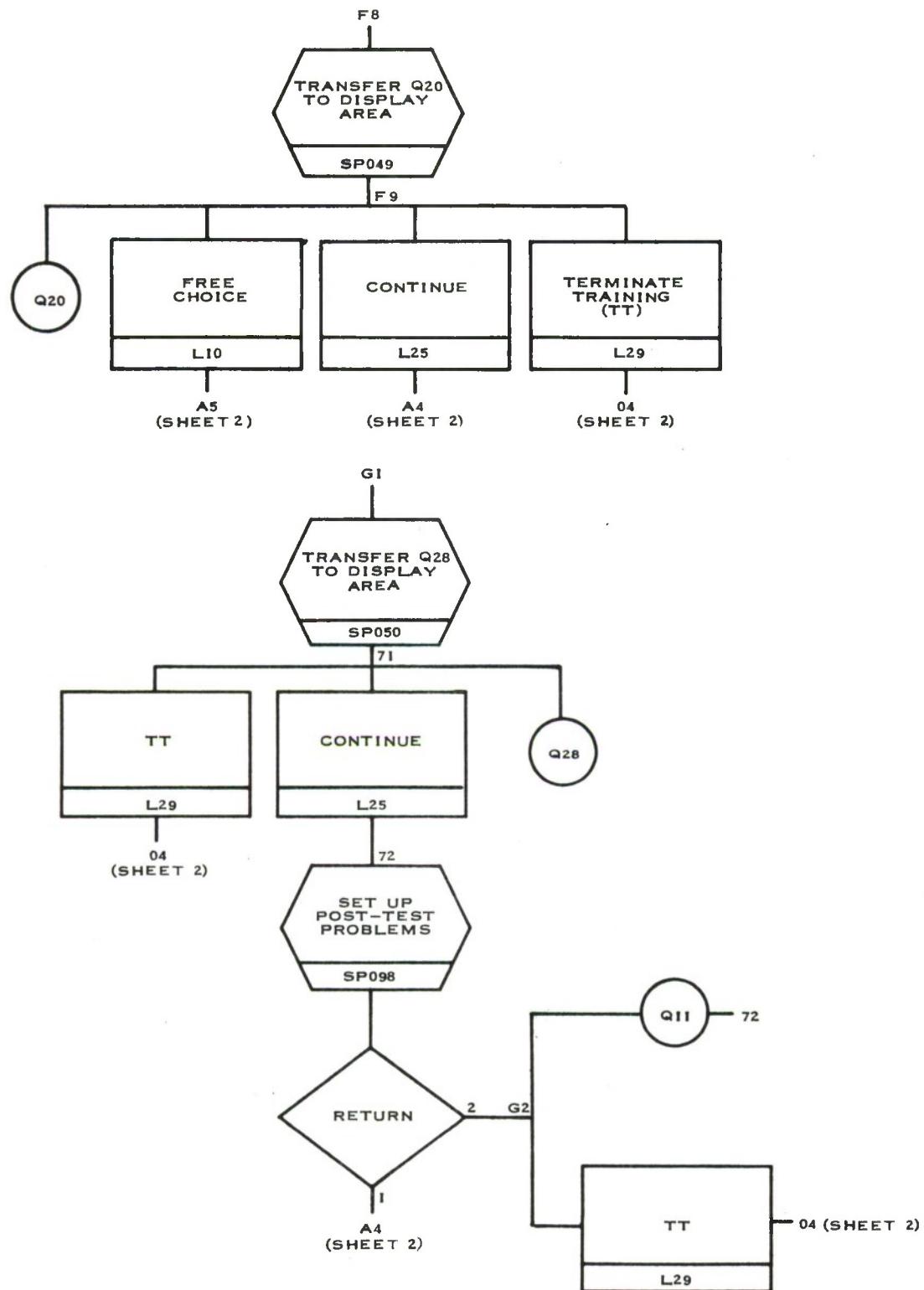


Detailed Procedural Flow (Sheet 1)

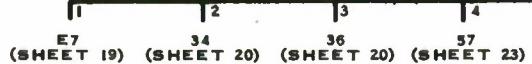
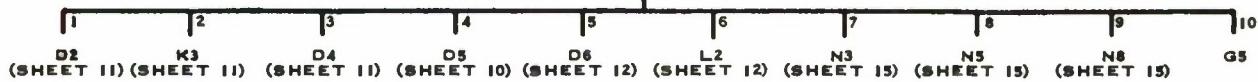
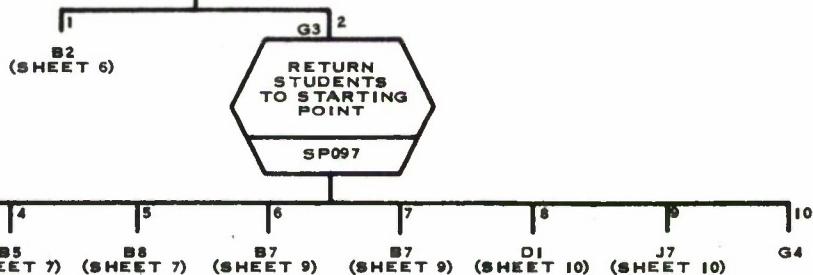




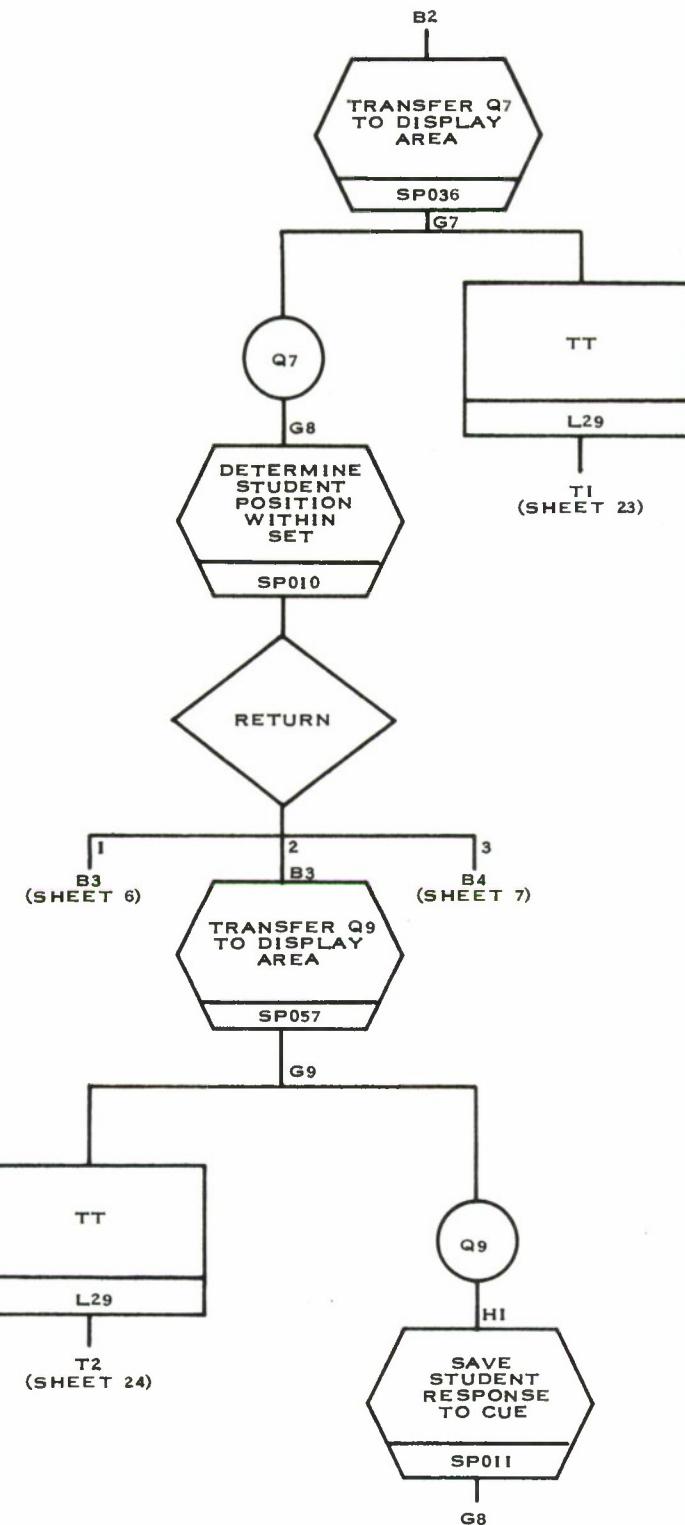
*Detailed Procedural Flow (Sheet 3)*



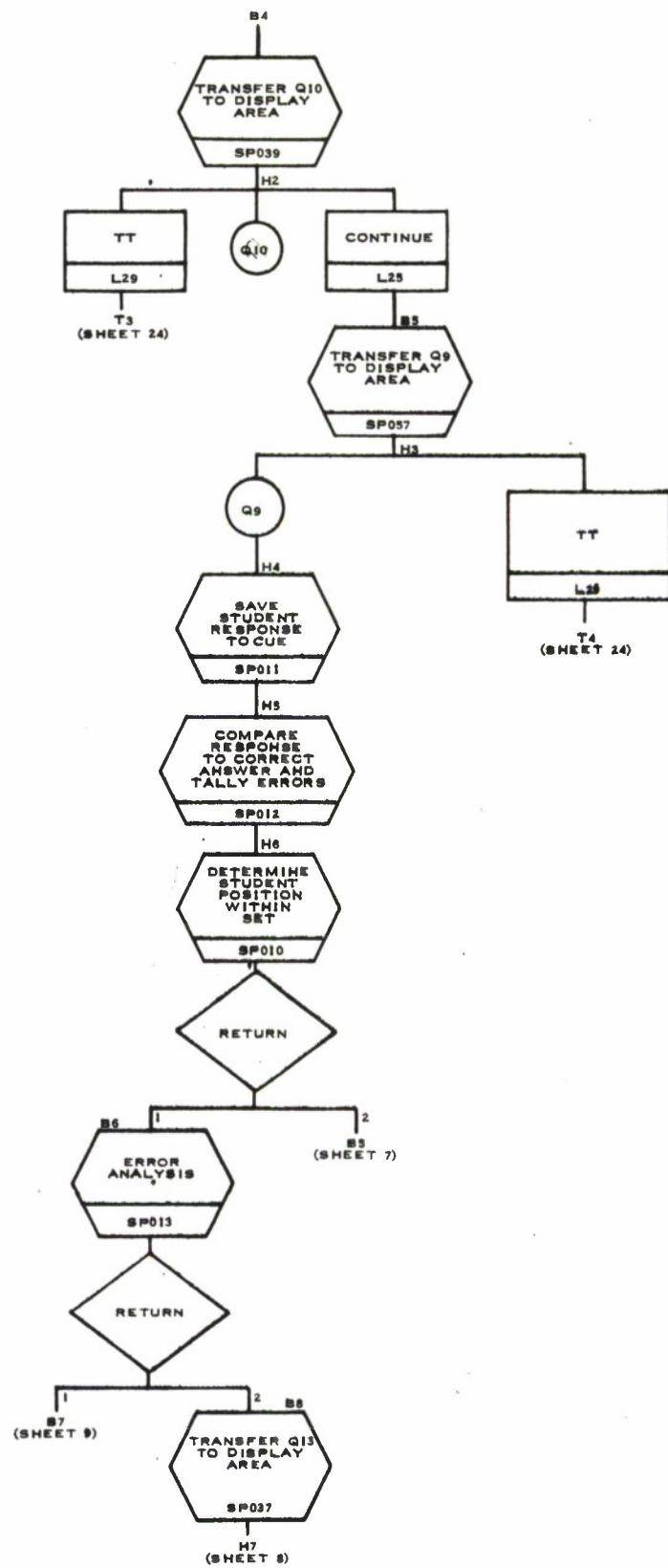
*Detailed Procedural Flow (Sheet 4)*



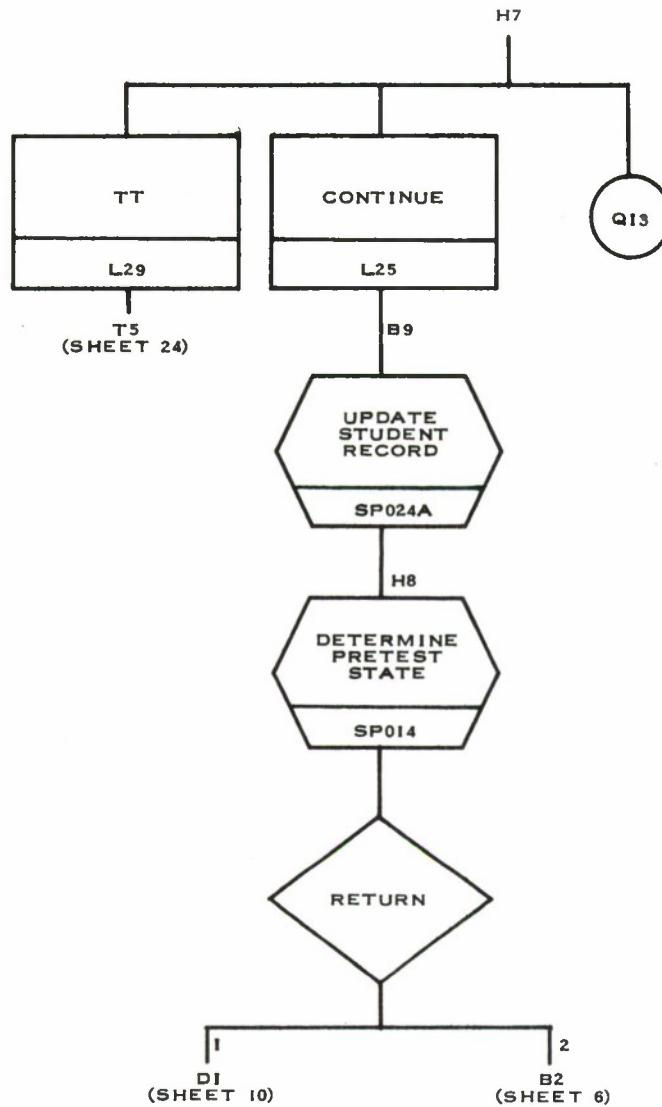
### *Detailed Procedural Flow (Sheet 5)*



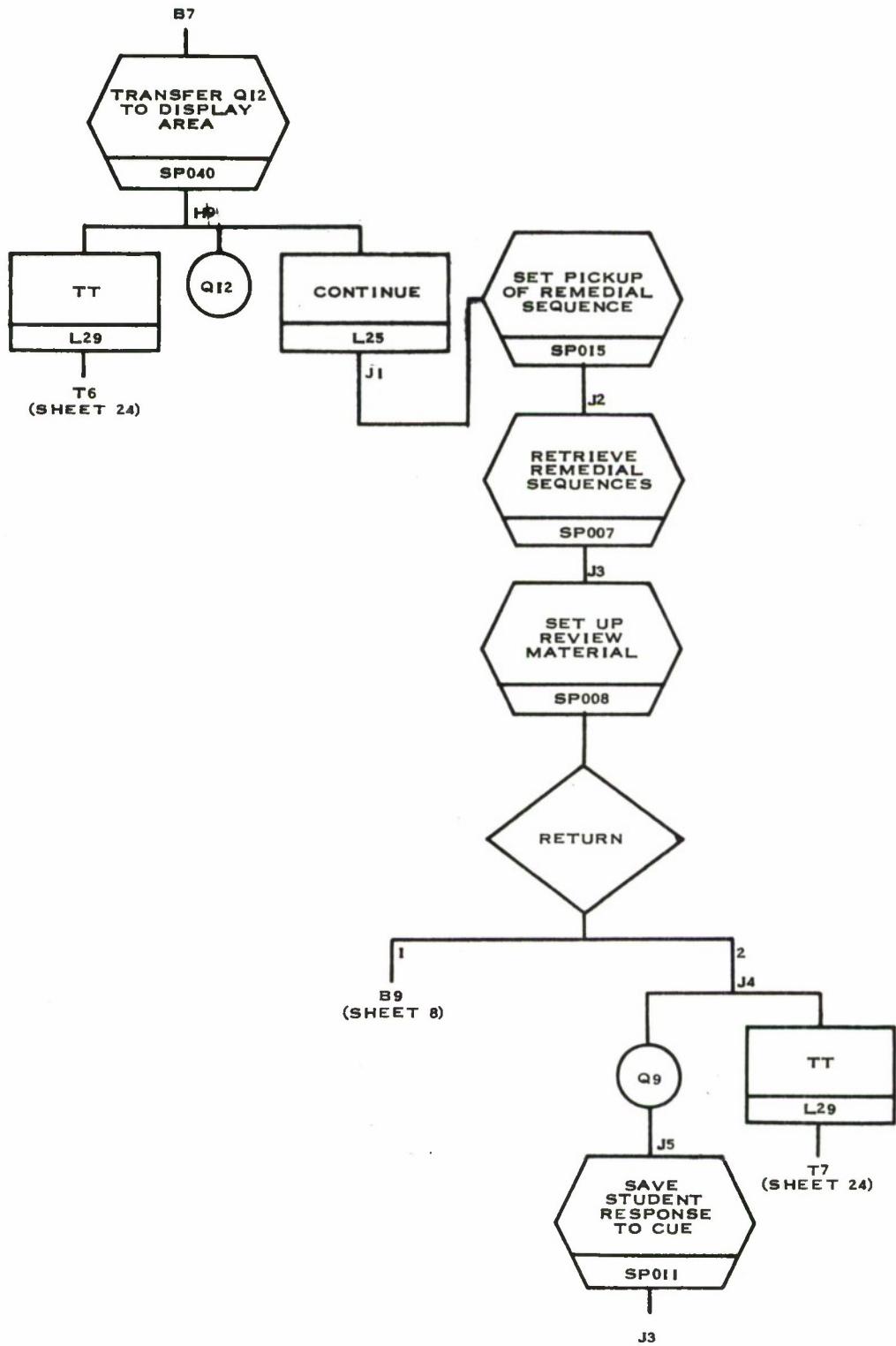
*Detailed Procedural Flow (Sheet 6)*



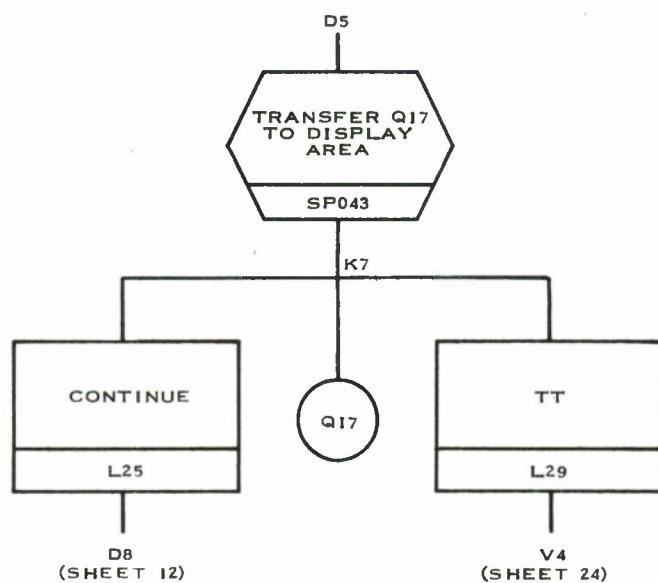
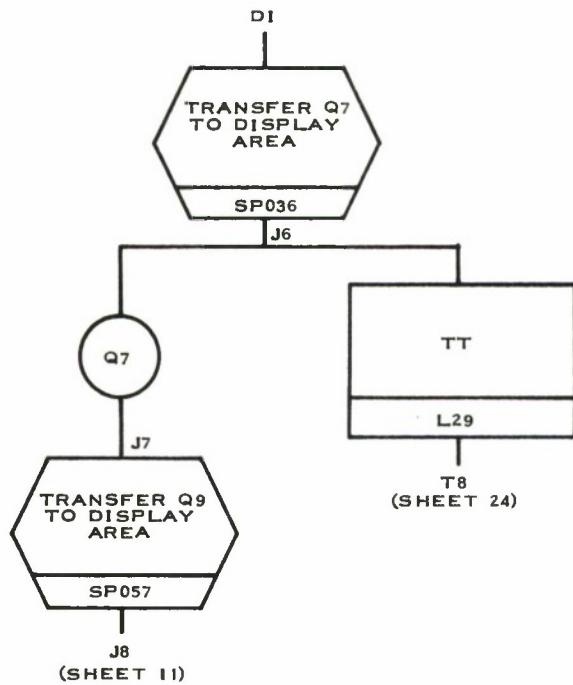
*Detailed Procedural Flow (Sheet 7)*



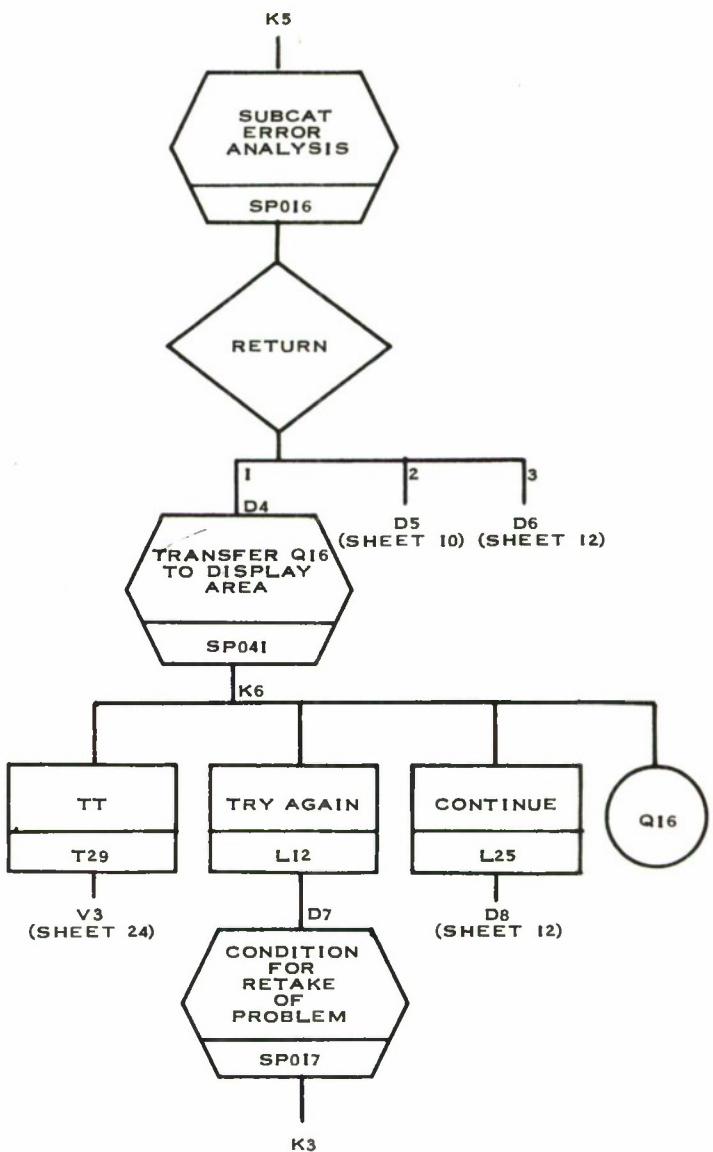
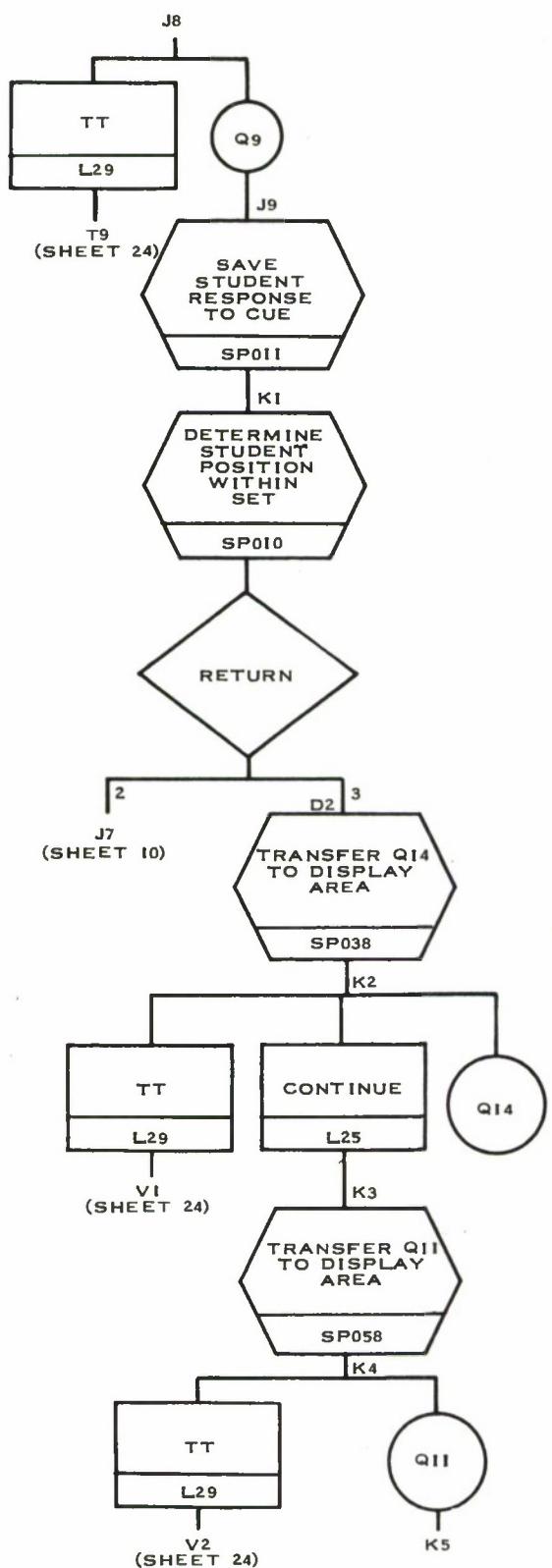
*Detailed Procedural Flow (Sheet 8)*



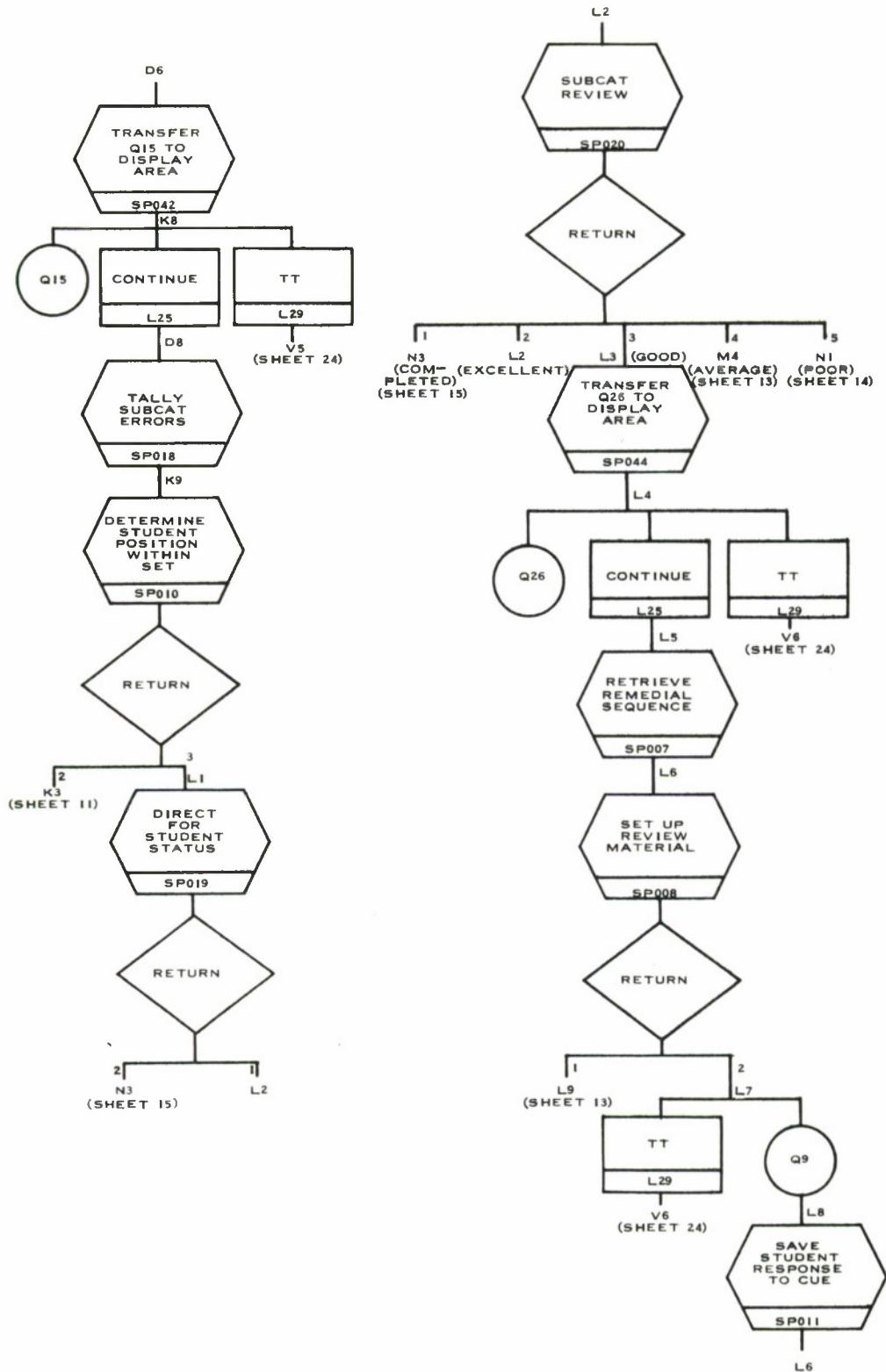
*Detailed Procedural Flow (Sheet 9)*



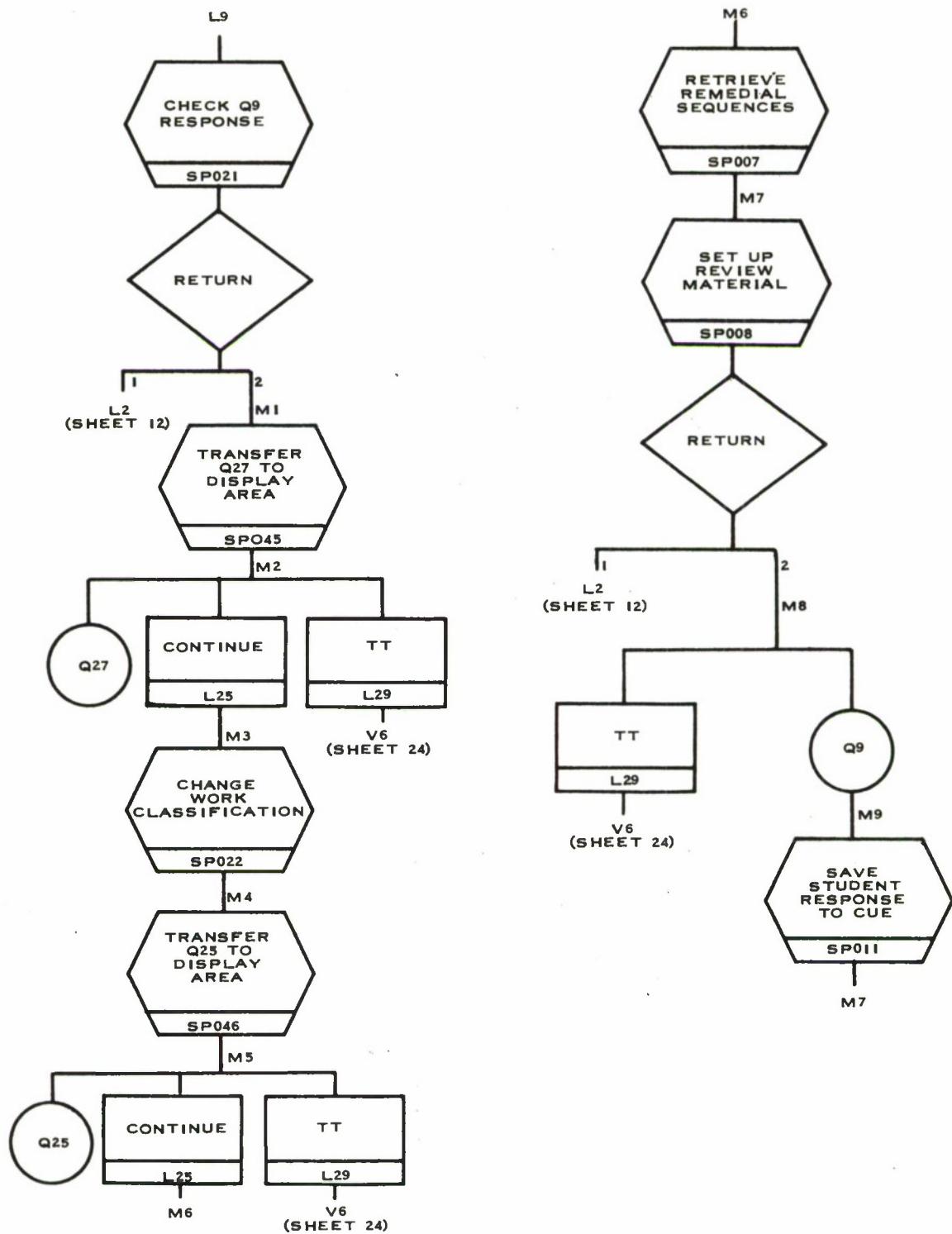
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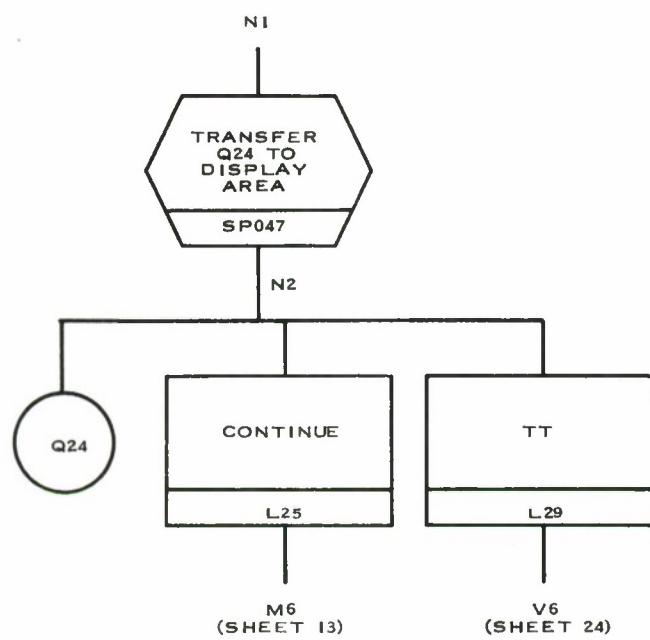
*Detailed Procedural Flow (Sheet 11)*



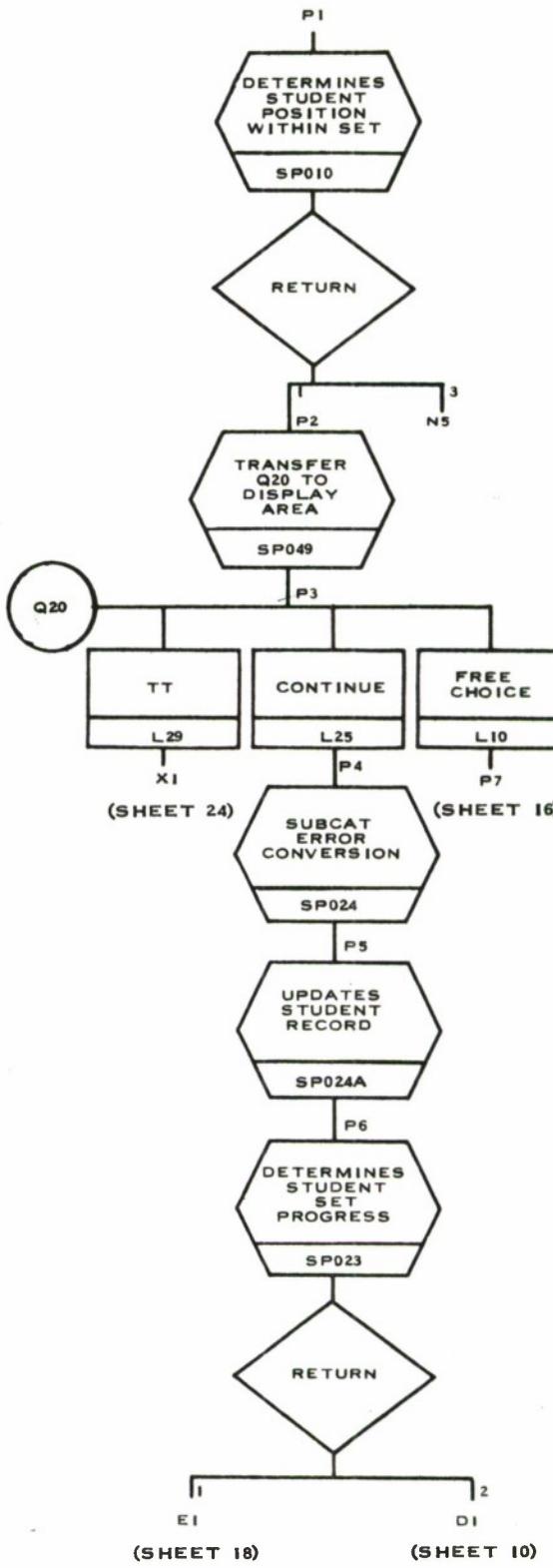
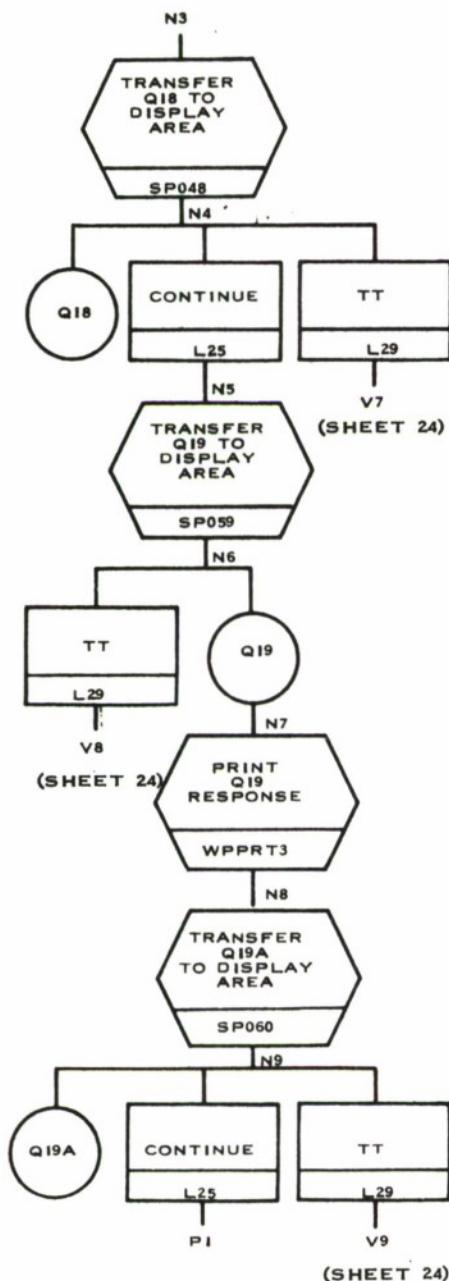
*Detailed Procedural Flow (Sheet 12)*



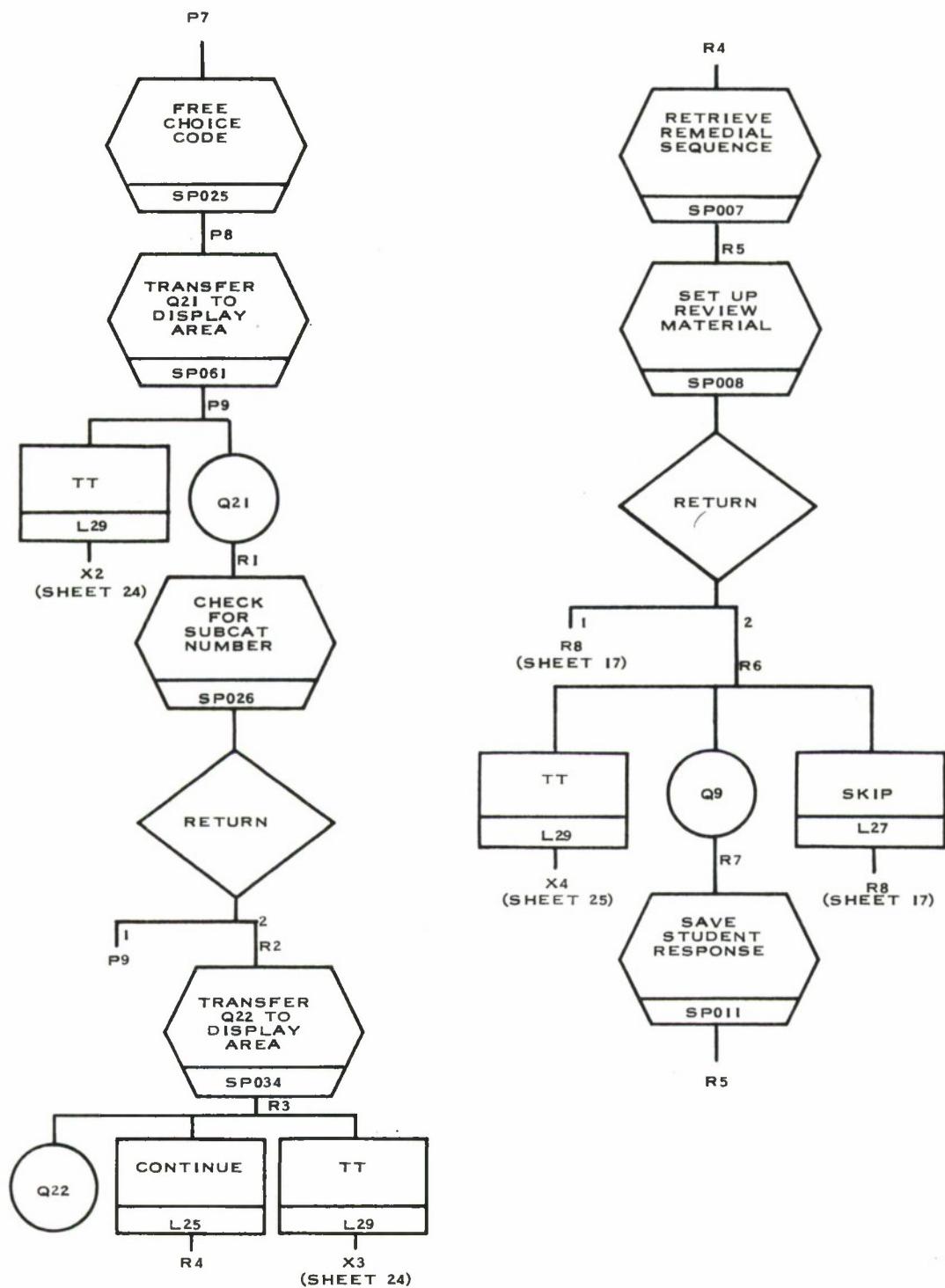
*Detailed Procedural Flow (Sheet 13)*



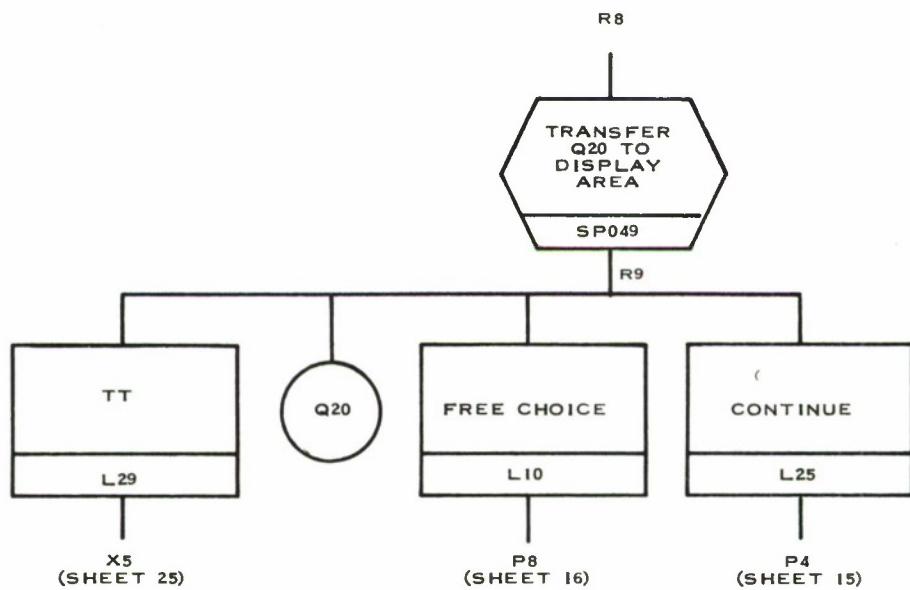
*Detailed Procedural Flow (Sheet 14)*



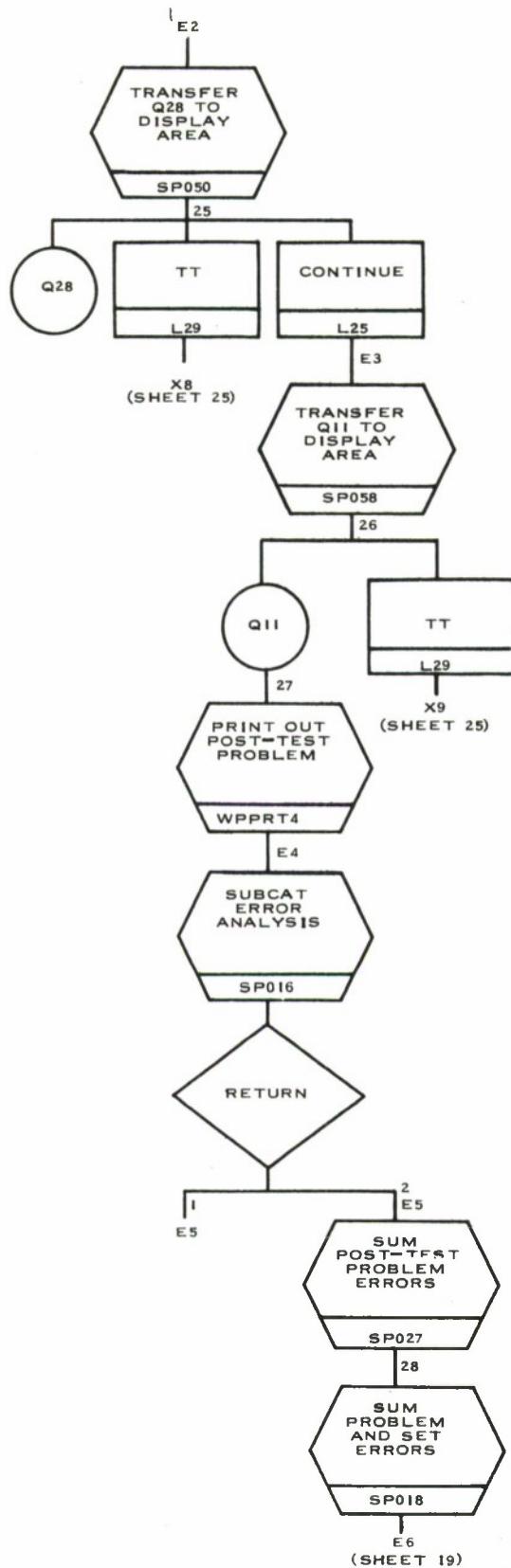
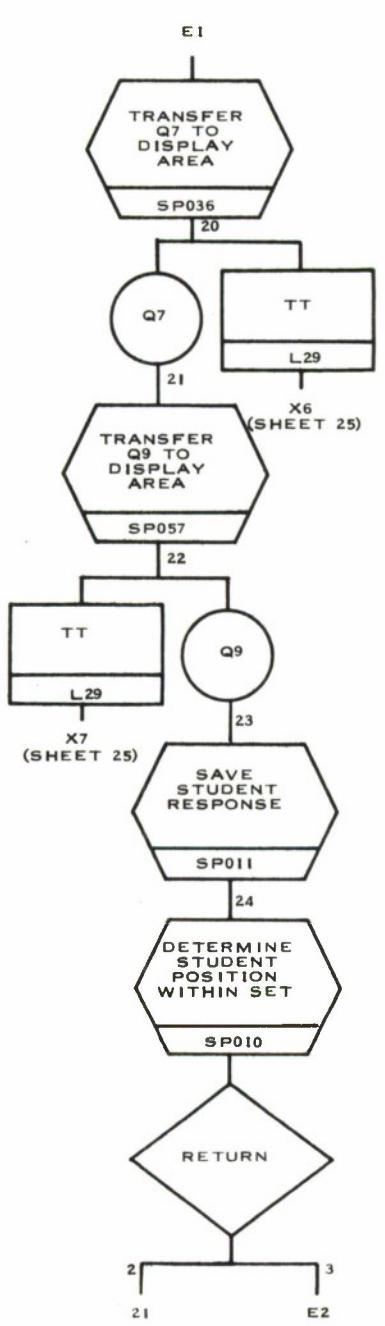
*Detailed Procedural Flow (Sheet 15)*



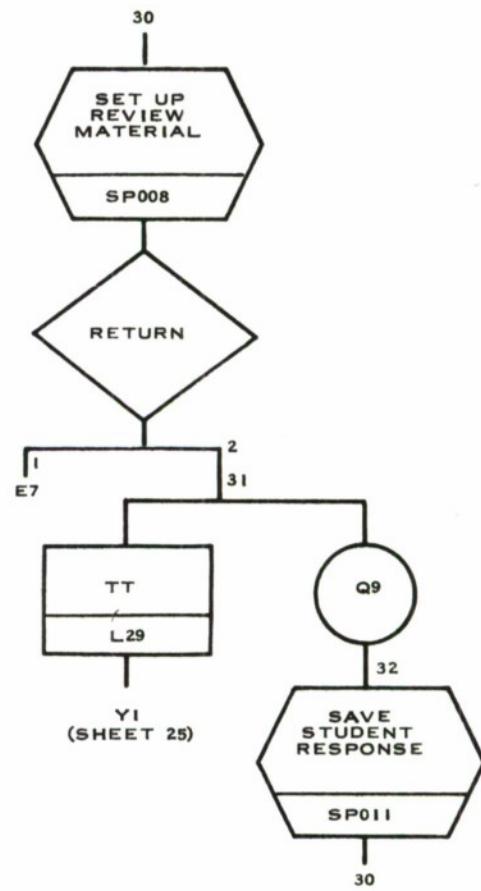
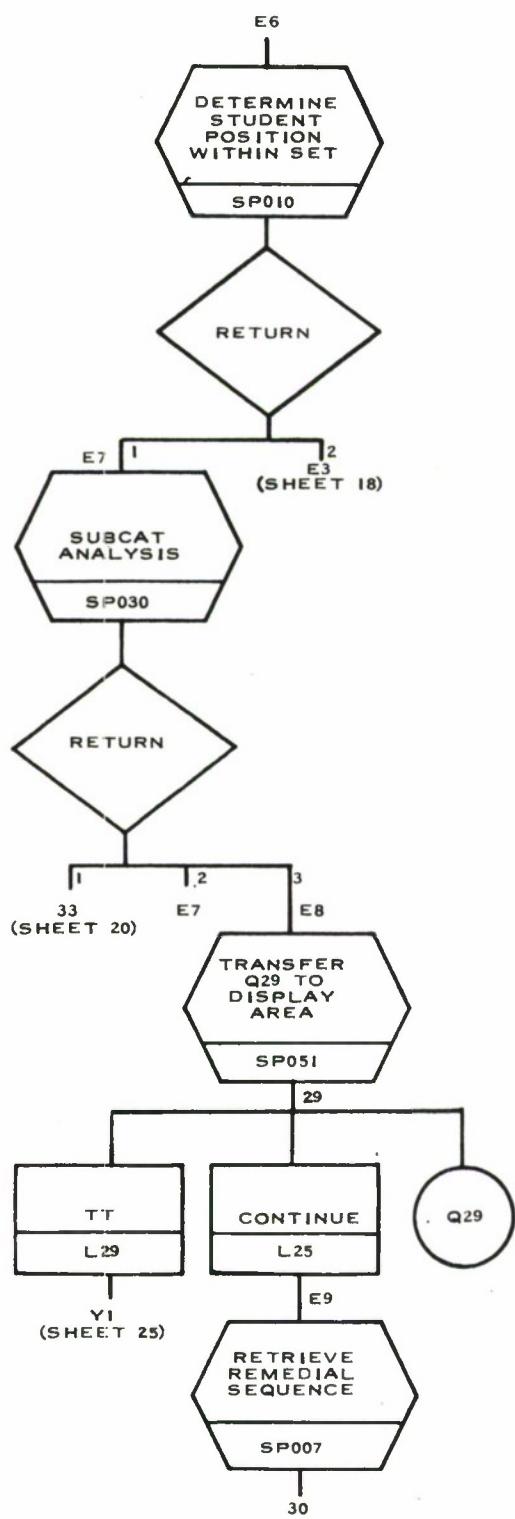
*Detailed Procedural Flow (Sheet 16)*



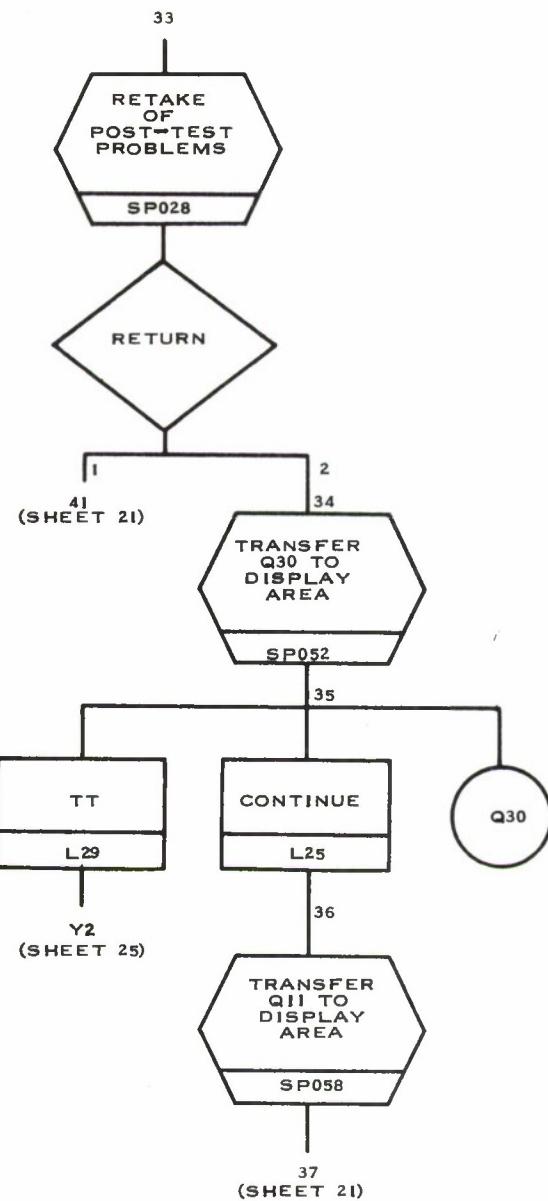
*Detailed Procedural Flow (Sheet 17)*



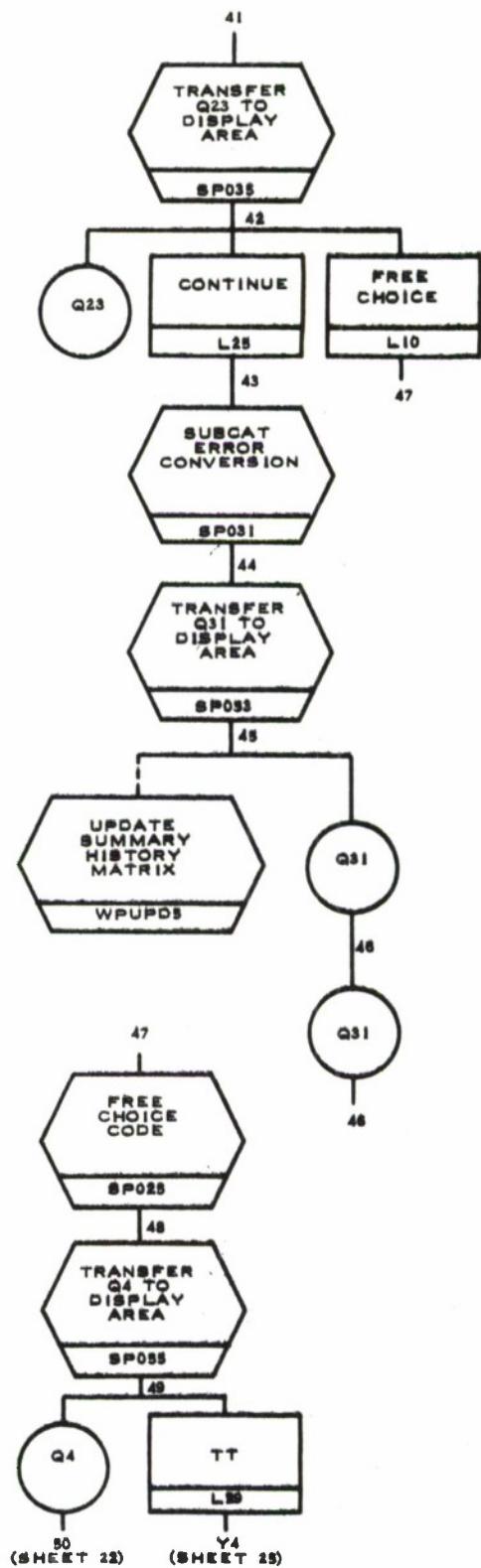
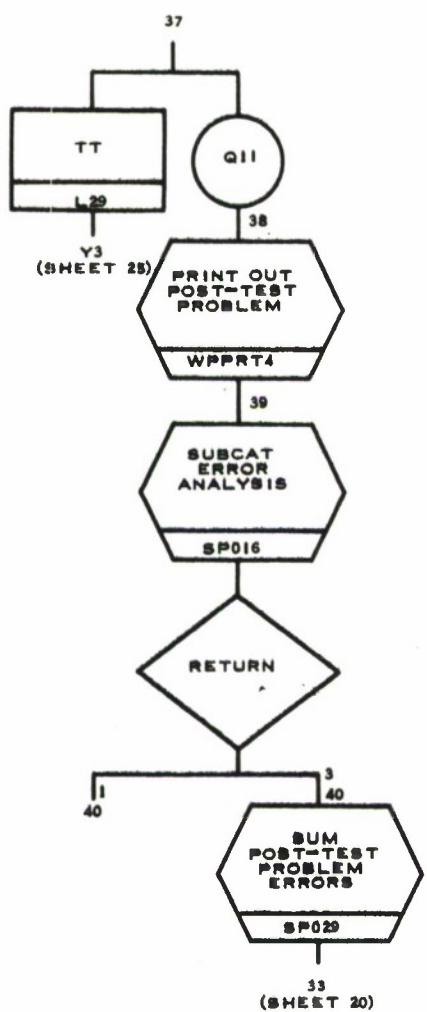
*Detailed Procedural Flow (Sheet 18)*



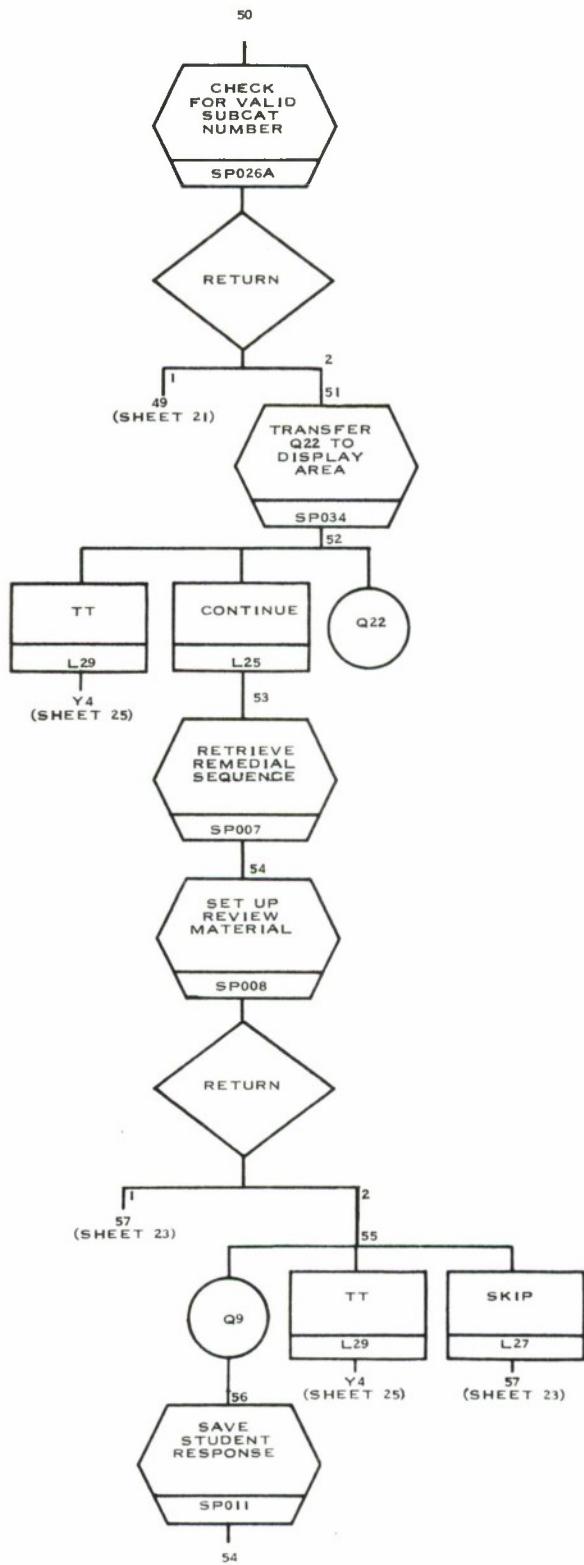
*Detailed Procedural Flow (Sheet 19)*



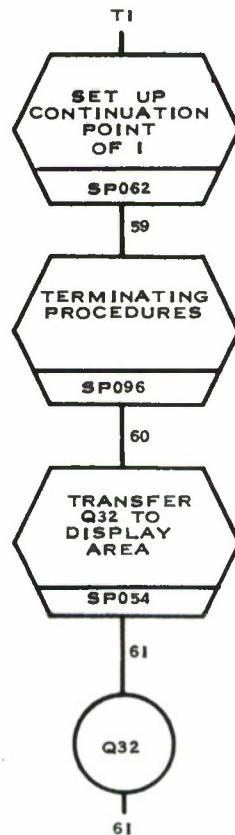
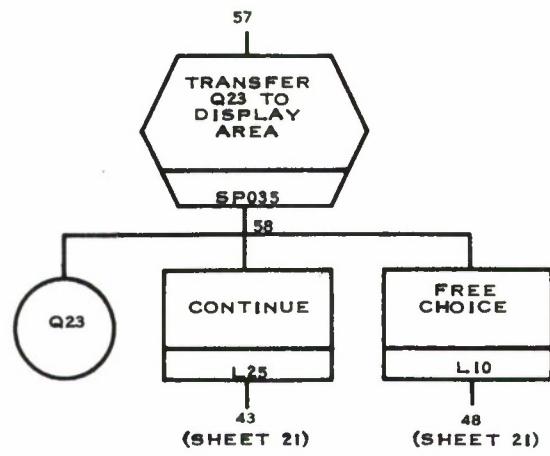
*Detailed Procedural Flow (Sheet 20)*



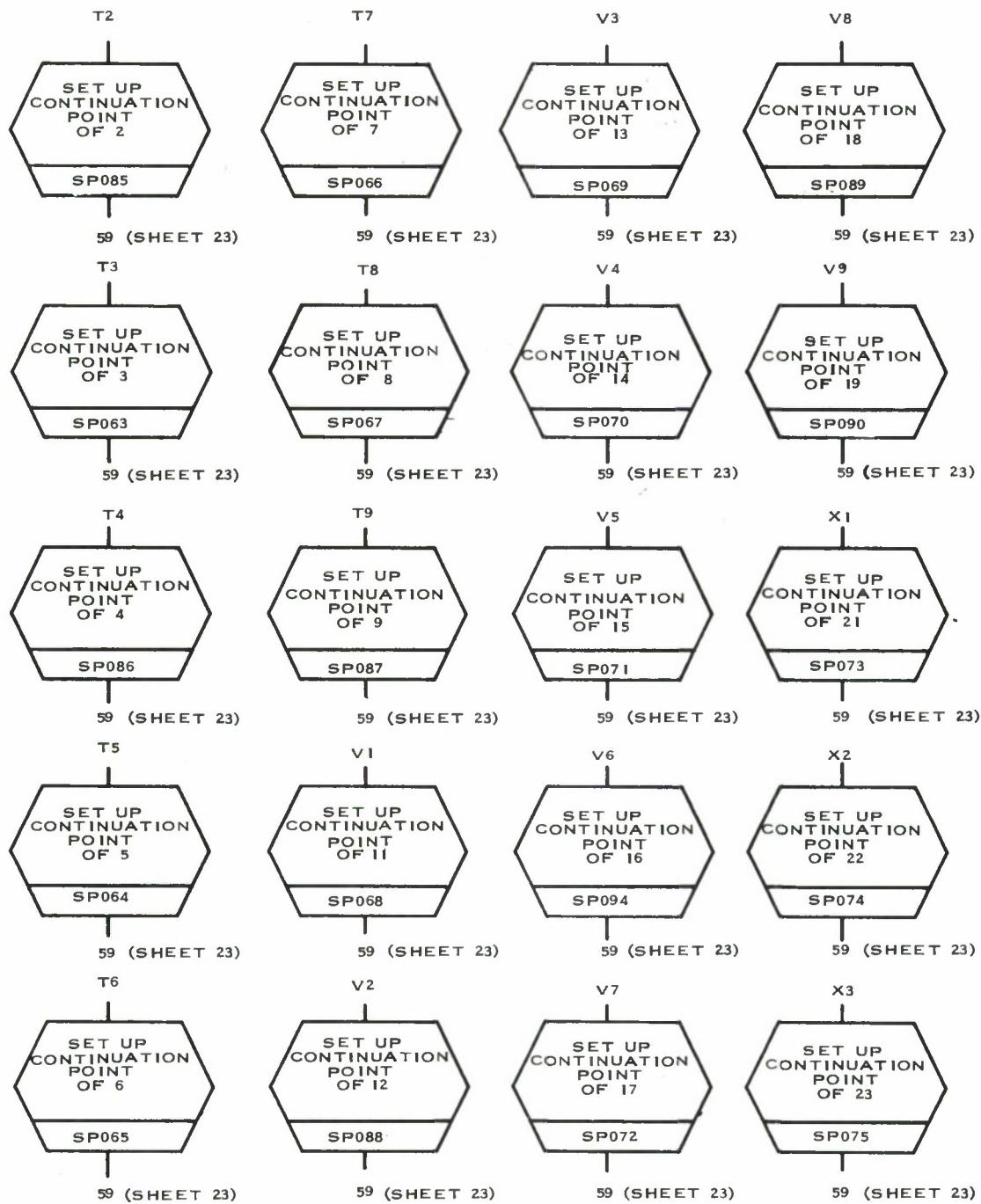
*Detailed Procedural Flow (Sheet 21)*



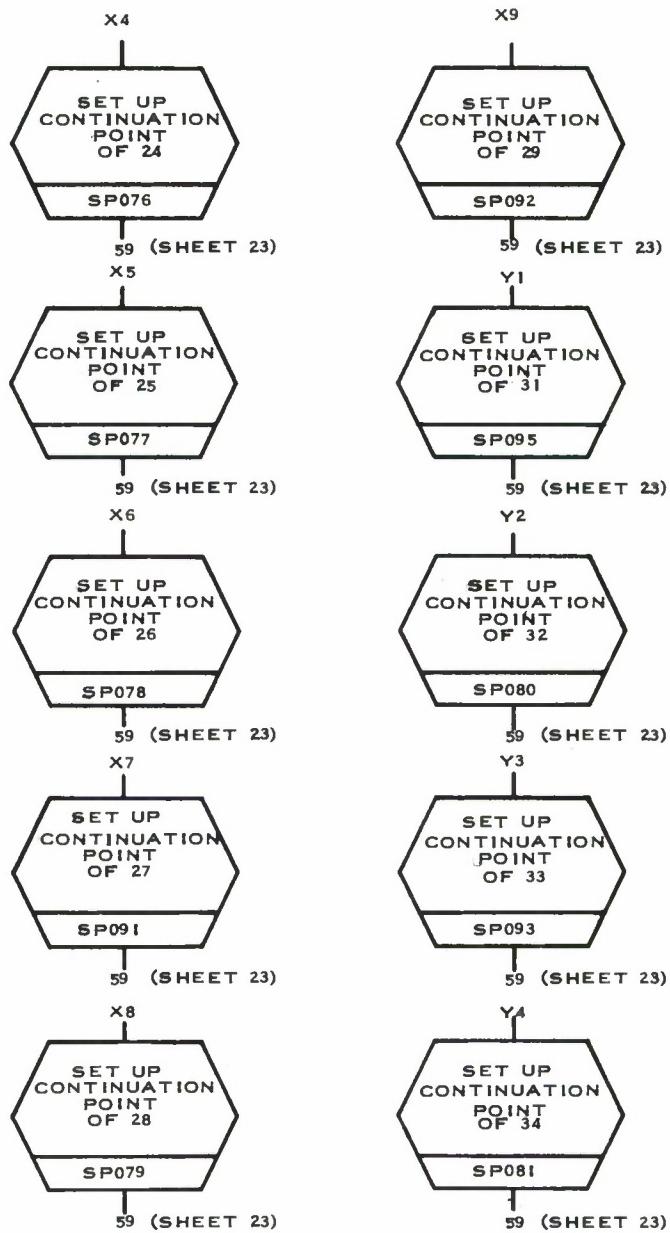
*Detailed Procedural Flow (Sheet 22)*



*Detailed Procedural Flow (Sheet 23)*



*Detailed Procedural Flow (Sheet 24)*



*Detailed Procedural Flow (Sheet 25)*



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## 13. ABSTRACT

This document describes the results of a programming analysis of a Computer Directed Training (CDT) capability as specified in a preliminary document developed by the American Institutes for Research entitled "Operational Specification for Computer Directed Training in Intermediate Query Language, Model II for System 473L, US Air Force Headquarters", February 1966. The programming analysis report describes a method for implementing the CDT capability and discusses the impact on System 473L operational utilization. Conclusions regarding the implementation of CDT capability are supported by a discussion of data storage, handling, and maintenance procedures; descriptions of data areas and subprograms; and a program flow chart with a listing of program logic steps.

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REPLY TO  
ATTN OF: ESE/5322

7 October 1968

SUBJECT: Review of Technical Document

TO: ESTIP

ESE has no objection to release of ESD-TR-66-261 to the CFSTI. However, it would seem appropriate to add a note to the description of the 473L System explaining that this is what was originally planned but was never carried through.

*John T. O'Brien*

JOHN T. O'BRIEN  
Chief, Public Information Division  
Information Office

1 Atch  
n/c